

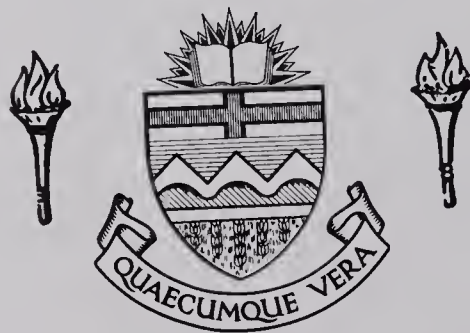
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AN INVESTIGATION INTO THE MODAL SPLIT RELATIONSHIPS
IN THE CITY OF EDMONTON

by



DALE BRIAN RHYASON


A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

DEPARTMENT OF CIVIL ENGINEERING

EDMONTON, ALBERTA

October 1967



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FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled AN INVESTIGATION INTO THE MODAL SPLIT RELATIONSHIPS IN THE CITY OF EDMONTON submitted by DALE BRIAN RHYASON in partial fulfilment of the requirements for the degree of Master of Science.

ABSTRACT

The purpose of this study was to evaluate the effect of transportation changes, area of employment and parking availability on the modal split relationships for the home-to-work movement destined to the Central Business District. Investigations were carried out as to the main factors affecting choice of mode, the effect of arrival time on mode split and the reliability of travel time ratio and travel time difference as measures of relative travel time.

During the period being studied there were major changes made to the transit routes in the City while no significant changes occurred in the street network or in the Central Business District employment. It was therefore possible to measure the effect of the transit changes on the modal split relationships.

Origin-destination surveys conducted in conjunction with the civic census in 1961 and 1964 formed the major data for this study with a ten percent sample being used in 1961 and a one hundred percent sample in 1964. Most of the other data used in this study was obtained in 1961 for the Metropolitan Edmonton Transportation Study.

The lack of complete data hampered the study to some extent and necessitated a number of assumptions. Travel costs, car ownership, average incomes and 1964 car travel time were the chief areas in which data was not available. Therefore the effect of relative travel costs

was not investigated in this study. It was assumed that car travel time did not change between 1961 and 1964 but this assumption later proved incorrect for the cross-river movements and bridge penalties had to be added for 1964. The bridge penalties varied from one minute for the Dawson Bridge to five minutes for the Low Level Bridge.

Since house sale values remained constant between 1961 and 1964 and correlated quite closely to the average income and car ownership figures of 1961 it was used as a measure of economic status.

The modal split relationships arrived at show the chief factors affecting the choice of mode in Edmonton to be economic status and relative travel time. Frequency of service and service time ratio did not have a measureable effect on the modal split relationships.

The main conclusions of this study were:

1. The radical changes in transit service did not affect the modal split relationships but did increase mode split by decreasing transit travel time.
2. The modal split relationships in Edmonton are dependent on the area of employment within the Central Business District.
3. There is no significant difference between the reliability of the modal split relationships using travel time ratio and those using travel time difference as measures of relative travel time.

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4. Planning Department

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GLOSSARY

- Car Ownership:** The number of private passenger cars per dwelling unit.
- CBD (Central Business District):** An area near the city center which is used for the retailing of goods and services for a profit and the performing of various office functions.
- Cost Ratio:** The travel cost by transit (fare) divided by the travel cost by car (gas, oil and parking).
- Excess Travel Time:** The time spent walking to and from the bus, waiting for the bus and transferring or the time spent parking and unparking the car and walking from the parking location.
- METS:** Metropolitan Edmonton Transportation Study
- Mode Split (Modal Split):** The proportion of people that will use each of the forms of transportation available to them under a given set of conditions. For this study mode split is taken as the proportion of people using transit and is expressed as a percentage.
- Running Time:** The time spent in a vehicle in getting from one point to another. This does not include the time required to park or unpark a car.
- Service Time Ratio (Service Ratio):** The ratio of excess travel time by transit to excess travel time by car.
- Travel Time:** The total time required to travel between an origin and a destination which is the running time plus the excess travel time.
- Travel Time Difference:** The transit travel time minus the car travel time expressed in minutes.
- Travel Time Ratio:** The total transit travel time divided by the car travel time.

CHAPTER I

INTRODUCTION

The provision of efficient transportation facilities is one of the greatest problems facing urban centers at the present time. These facilities must be of sufficient capacity and in the proper location to meet the needs of the majority of the users. In planning a transportation system, studies must be carried out and analyses of travel patterns and travel trends must be made.

One of the more critical analyses required is the determination of the proportion of people using the various forms of transportation available to them. Although the forms of transportation could consist of public transit, private car, bicycle, taxi, or walking, the forms (modes) usually considered in North America are public transit and the private car since the other forms are insignificant. Thus mode split becomes the proportion of people that will ride transit under a given set of conditions.

Modal split relationships are the basis from which the capacity determinations of transportation facilities are calculated. Therefore it is important that the limitations of the modal split relationships be fully understood when using these relationships to predict volumes for a proposed transportation facility.

Numerous factors are involved in the choice of mode and being

a personal choice the relative importance of these factors may differ among individuals. Other researchers have found relative travel time, relative travel cost, trip purpose, economic status and relative level of service to be the factors having the greatest effect on the choice of mode (Hill and Von Cube, 1963). Relative travel time is expressed as a ratio of the travel times or as the difference between the travel time. Relative level of service is expressed as a ratio of the excess time (walking, waiting and transfer) by transit to the excess time (parking and walking) by car. Other factors are involved in the choice of mode but most have been found to be linearly dependent on one or more of the above factors (Hill and Von Cube, 1963; Hill and Dodd, 1966).

The most reliable modal split determinations are those based on the home-to-work movement as these trips are usually made over a two hour period and are consistent throughout most of the year. All other trips, with the exception of those to school, may occur at any time during the day and may vary from day to day, making reliable modal split relationships difficult to establish. The home-to-work relationships should give a fairly accurate representation of travel patterns as most of the trips made during the peak hours of 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. are between home and work.

Purpose of the Thesis

This investigation deals with the establishment of modal split relationships for home-to-work trips destined to the Central Business District in an attempt to assess the following points:

1. The main factors affecting the choice of mode.
2. Effects of transportation changes on the modal split relationship.
3. The correlation of the area of employment and the parking availability with mode split.
4. The reliability of travel time ratio and travel time difference as measures of relative travel time.
5. The effect of arrival time on the mode split.

Origin-destination data collected in 1961 and 1964 by the City of Edmonton will be used in establishing the modal split relationships. During this period there were no major changes in the street network but the transit routes were drastically changed. Thus in measuring the effect of the transportation changes the transit changes will be those which are measured.

Limitations of the Study

The two major limitations of this study were the lack of time available in which to carry out the study and the lack of reliable data for many of the determinations required. The effect of relative travel cost was not investigated in this study due to lack of travel cost data and lack of time to calculate the necessary information. Assumptions had to be made for such factors as 1964 auto travel time, parking and walking time for autos, and waiting time for transit as this information was not available. The lack of income figures for 1964 necessitated

the adoption of house sale value as an economic indicator. A 10 percent sample in the origin-destination survey as used in 1961 severely limits the reliability of the modal split relationship when small areas are being considered as is the case in this study.

Organization of the Thesis

The investigation was carried out by first considering the modal split relationships established for Edmonton in the "Metropolitan Edmonton Transportation Study" (Edmonton District Planning Commission, 1963) and in the study on "Estimate of Usage of the Proposed Edmonton Rapid Transit System" (Traffic Research Corporation Ltd., 1963). This was followed by a study of the population, employment and transportation changes and the calculation of the various factors involved in the determination of the modal split relationships. These factors included the travel times by auto and by transit, the economic status in the origin zones, the mode split for each zone to zone movement, and the parking availability in the Central Business District.

Using this data the modal split relationships were determined for both 1961 and 1964 followed by a discussion and comparison of these relationships in order to obtain the results which were being investigated. The final chapter of the thesis contains the conclusions and recommendations of the investigation.

CHAPTER II

PREVIOUS MODE SPLIT ANALYSES CONDUCTED IN EDMONTON

Two mode split analyses have been conducted using the 1961 origin-destination data for the City of Edmonton. The first analysis was done by Barton-Aschman Associates, Inc. for the "Metropolitan Edmonton Transportation Study" (METS) and the second was conducted by Traffic Research Corporation Limited in the "Estimate of Usage of the Proposed Edmonton Rapid Transit System".

The Metropolitan Edmonton Transportation Study (Edmonton District Planning Commission, 1963)

Although the methods used in determining the modal split relationships for the METS are not outlined in the report, the modal split relationships are given for work trips destined to the Central Business District. These relationships are shown on FIGURE 2-1.

Travel time difference which is the total transit travel time minus the total car travel time was used as the measure of relative travel time in this study and car ownership was used as an economic indicator. It was felt that car ownership played a more important role in the choice of mode than income.

The traffic zones which were established for the METS were also used in the 1964 origin-destination survey and are therefore the

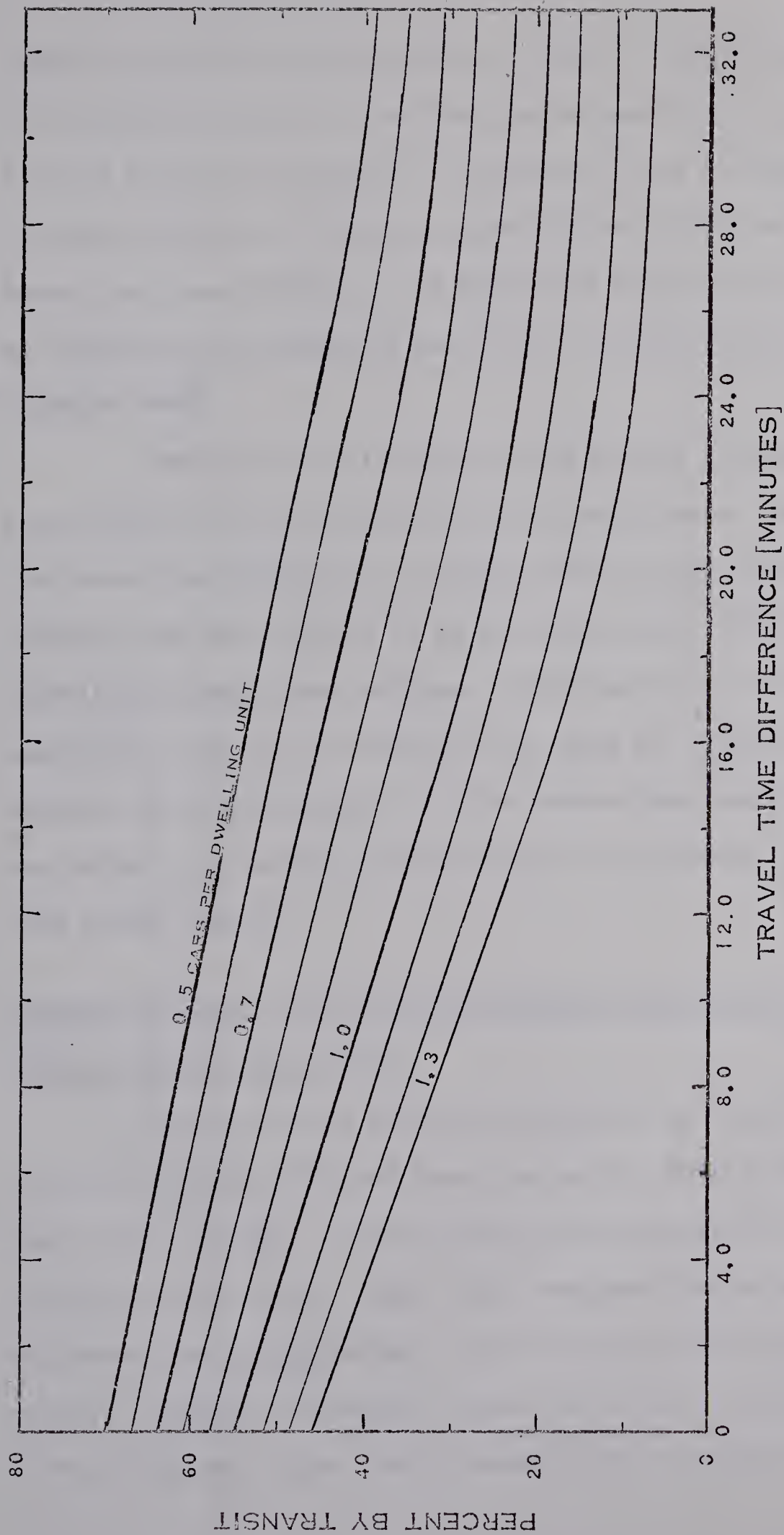


FIGURE: 2.1 1961 MODAL SPLIT RELATIONSHIPS AS DETERMINED FOR METS
 [FROM EDMONTON DISTRICT PLANNING COMMISSION, 1963]

zones used in the present analysis. FIGURE 2-2 shows the traffic zones and traffic districts for the Edmonton Metropolitan area. The Central Business District is composed of Districts 1 and 2 although the area in these districts is larger than that normally referred to as the Central Business District. The additional area includes that used for parking by CBD employees and is the area with natural boundaries on three sides.

The only criticism which could be made of these zones is that the boundaries were established along streets rather than along lanes. This means that buildings on opposite sides of the street although of the same land use type may be in different zones. With zone boundaries established along lanes buildings facing any street would be in the same zone. However the advantages of using the streets as boundaries outweigh the disadvantages since the census zones and polling districts use streets as boundaries and most data are collected in conjunction with census taking.

Estimate of Usage of the Proposed Edmonton Rapid Transit System (Traffic Research Corporation, 1963)

The mode split analysis carried out by Traffic Research Corporation was quite different from that for the METS although the same basic data were used. Travel time ratio, which is the transit travel time divided by the car travel time, was used instead of travel time difference and average worker income was used as a measure of economic status. The ratio of transit travel cost to car travel cost and the service time ratio were used in establishing the modal split relation-

METROPOLITAN STUDY AREA

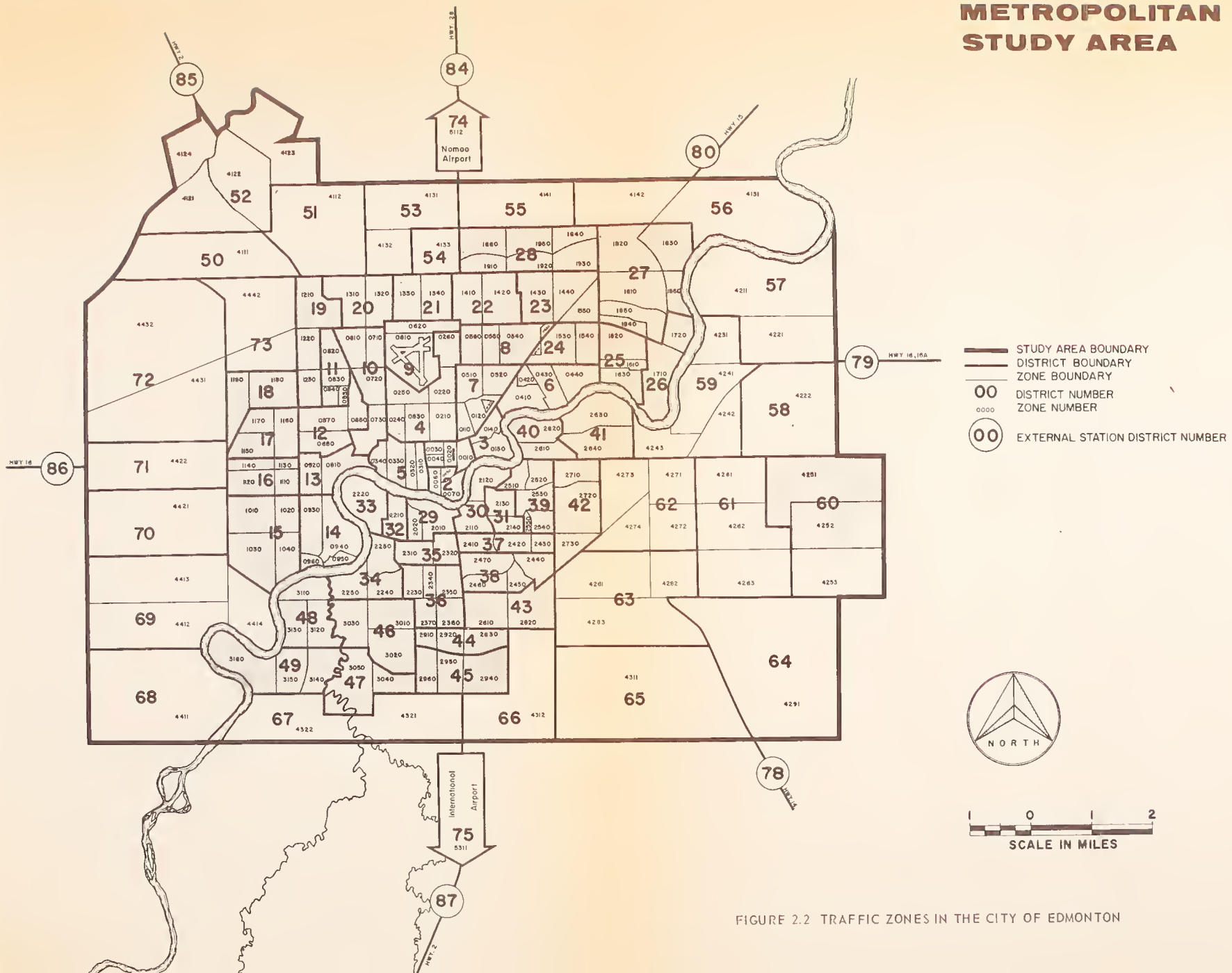


FIGURE 2.2 TRAFFIC ZONES IN THE CITY OF EDMONTON

ships. Service time ratio was calculated as the walking, waiting and transfer time for transit divided by the parking and walking time for cars. The average parking and walking time for cars was estimated to be four minutes at the destination end of the trip and zero at the origin end. Excess transit travel time was calculated for each zone to zone trip.

Income was divided into ranges of \$0 to \$2900, \$2900 to \$4500, \$4500 to \$5900, \$5900 to \$7100 and \$7100 and over. However, curves were only shown for a combination of \$0 to \$4500 and for \$4500 to \$5900. Cost ratio and service ratio were each divided into four ranges with those for cost ratio being 0 to 0.5, 0.5 to 1.0, 1.0 to 1.5 and greater than 1.5 and those for service ratio being 0 to 1.5, 1.5 to 3.5, 3.5 to 5.5 and greater than 5.5.

Having broken the data into the various levels of income, cost ratio and service ratio, regression analysis was used to determine the mode split curves. Observations were grouped within equal intervals of travel time ratio as was done in other studies conducted by Traffic Research Corporation (Hill and Von Cube, 1963). The points were grouped by using a weighted average of the travel time ratios and of the mode split for all zones falling in the interval with the number of trips from the zone being the weighting factor. The grouped points were then plotted and the mode split curves were drawn as shown on FIGURE 2-3. On this figure the effects of cost ratio and service ratio seem relatively small considering the scatter of points. It would seem that the accuracy would have been almost the same with only one curve being drawn for each income range.

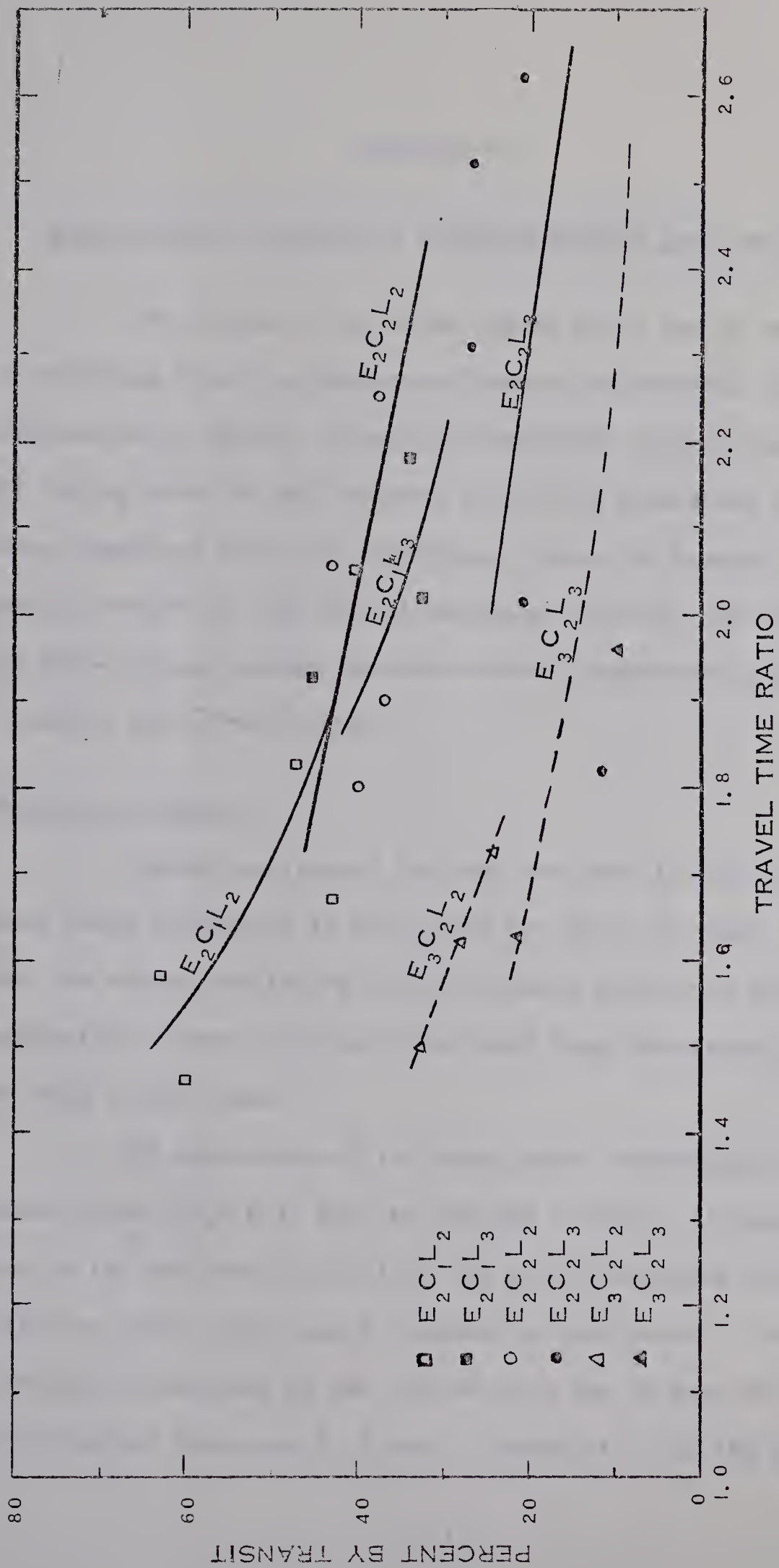


FIGURE: 2.3 1961 MODAL SPLIT RELATIONSHIPS AS DETERMINED BY TRAFFIC RESEARCH CORPORATION

[MODIFIED FROM TRAFFIC RESEARCH CORPORATION LTD., 1963]

ECONOMIC LEVEL	COST RATIO	SERVICE RATIO
E_2 \$0 - \$4500	C_1 0.0 - 0.5	L_2 1.5 - 3.5
E_3 \$4500 - \$5900	C_2 0.5 - 1.0	L_3 3.5 - 5.5

CHAPTER III

SOME PERTINENT CHANGES IN EDMONTON BETWEEN 1961 AND 1964

The changes in an urban center which are of particular interest in analyzing travel patterns are those in population, employment and the transportation system. Population increases in most North American cities are taking place in the suburban areas with population in older central areas remaining static or declining. Since the largest area of employment usually remains in the Central Business District, the travel time for the home-to-work journey increases unless improvements in the transportation system take place.

Population Changes

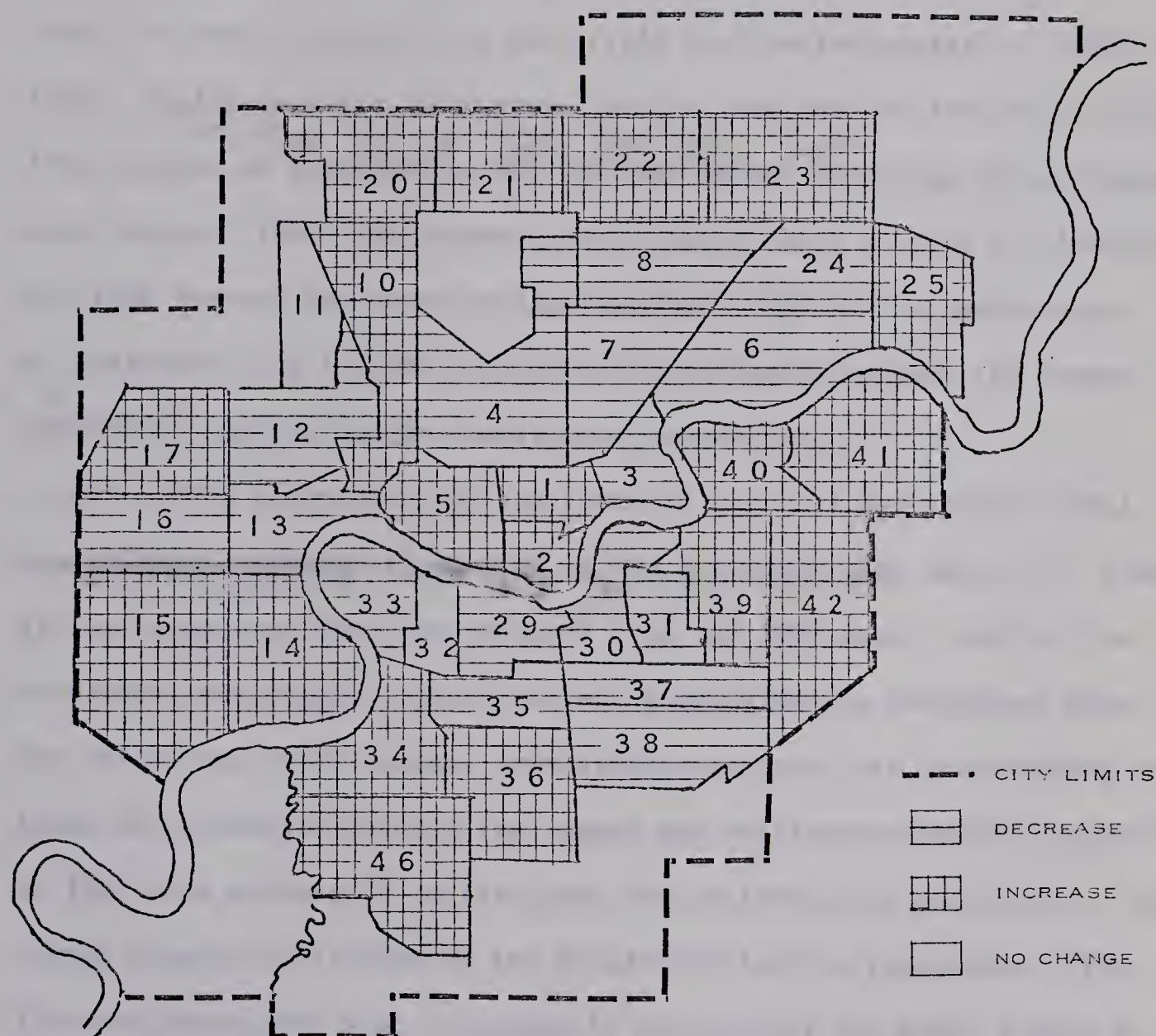
Population figures for 1961 and 1964 in each of the origin zones being considered in this study are shown in TABLE 3-I. For 1961 both the census population and the updated population from the origin-destination survey have been shown with large discrepancies occurring for some origin zones.

The population of the zones under consideration increased 10.6 percent from 312,776 in 1961 to 346,056 in 1964. As shown on FIGURE 3-1 most of the increase occurred in the newly developing peripheral zones while the older areas show a decrease in population. The effect of apartment development in the central area can be seen by the increase in population of districts 1, 2 and 5. District 11 is the only residential

TABLE 3-1

POPULATION AND EMPLOYMENT BY ORIGIN ZONE

Origin Zone	Population			Total Employees				Origin Zone	Population			Total Employees			
	1961 Census	1961 OD	1964 Census	1961 Number	1961 % of Pop.	1964 Number	1964 % of Pop.		1961 Census	1961 OD	1964 Census	1961 Number	1961 % of Pop.	1964 Number	1964 % of Pop.
CBD	6746	5870	6924	2410	41.0	2481	35.9	1310	7863	8160	8595	1910	23.4	2332	27.2
110	4305	3660	4142	720	19.7	650	15.7	1320	5340	5160	5942	1240	24.0	1853	31.3
120	4626	4430	4284	1160	26.2	1046	24.4	1330	3005	3080	4731	560	18.2	1347	28.5
140	3320	3220	3280	800	24.9	569	17.3	1340	3204	3300	6904	880	26.7	2004	29.0
150	4629	4260	4043	770	18.1	764	19.0	1410	1750	1750	4106	440	25.1	1281	31.2
210	3936	2160	3969	930	43.0	1357	34.2	1420	3028	2930	6855	610	20.9	1915	28.0
220	3207	2930	2797	840	28.6	820	29.3	1430	1968	1640	2713	370	22.5	735	27.1
230	3573	4440	3082	1540	34.7	1244	40.3	1440	2089	2170	3197	450	20.7	827	26.0
240	782	700	796	240	34.3	278	34.9	1520	5066	4590	4698	1090	23.7	1390	29.6
250	2357	2170	2059	760	35.0	799	38.8	1540	3426	3430	3352	880	25.7	1060	31.7
260	3162	3150	2634	850	27.0	857	32.5	1550	230	120	213	40	30.0	278	130.0
310	2406	2130	2595	1000	47.0	872	33.6	1620	5300	5300	5525	840	15.8	1335	24.2
320	2391	2330	2342	920	39.5	1068	45.5	1630	3640	3640	4655	880	24.2	1207	25.9
330	1951	1850	2286	660	35.7	880	38.5	2010	3514	3430	3507	930	27.1	866	24.8
340	2012	2000	2049	690	34.5	716	35.0	2020	3989	3280	3716	1060	32.3	884	23.8
410	2581	2570	2529	590	23.0	615	24.3	2110	6036	6030	5791	1740	28.9	1713	29.6
430	3577	3350	3417	980	29.3	901	26.4	2120	1710	1710	1625	460	26.9	403	24.8
440	3866	3930	3702	970	24.7	1166	31.4	2130	3745	3890	3277	850	21.9	1171	35.7
510	7106	6900	6606	2020	29.3	1952	29.5	2140	2344	1850	2186	580	31.3	555	25.4
520	5620	5730	5476	1450	25.3	1553	28.4	2220	2577	1960	1894	480	24.5	374	19.8
540	4125	3590	3971	1100	30.7	1337	33.6	2230	4081	3880	3942	1030	26.5	735	18.7
550	2866	3250	2714	780	24.0	876	32.3	2250	40	--	973	--	--	171	17.6
560	5359	5000	5447	1440	28.8	1193	22.0	2310	4672	4430	4142	1380	31.2	1124	27.2
710	2582	2480	2445	710	28.6	714	29.2	2320	2303	2230	2242	600	26.9	634	28.3
720	4628	4340	4984	1610	37.0	1766	35.4	2330	3752	5280	3477	1410	26.7	969	28.1
730	4495	4520	4828	1470	32.5	1370	28.4	2340	2981	1570	2865	370	23.6	899	31.4
810	4512	4770	4368	1240	26.0	1278	29.3	2350	1772	1680	1683	420	25.0	469	27.7
820	3853	3640	3851	1030	28.3	245	6.4	2360	871	920	2028	130	14.1	452	22.2
830	2532	2660	2566	660	24.8	652	25.4	2370	1433	1500	2885	400	26.7	752	26.1
840	672	710	627	140	19.7	241	38.5	2410	3122	3250	3010	1200	36.9	971	32.3
860	4110	4300	4115	1390	32.3	1110	27.0	2420	2792	2870	2658	720	25.1	653	25.5
870	5511	5850	5307	1570	26.8	1558	29.5	2430	2612	2450	2508	630	25.7	736	29.4
880	4991	4490	4704	1330	29.6	1520	32.3	2440	3567	3210	3670	550	17.2	1025	27.9
910	2139	1930	2117	510	26.4	602	28.5	2450	1524	--	1446	--	--	413	28.6
920	3243	3240	3119	820	25.3	913	29.3	2460	3509	3160	3487	920	29.1	1063	30.5
930	5079	5970	6111	1540	25.8	1592	26.1	2470	5311	5030	5010	1100	21.9	1300	26.0
940	2529	1320	2688	360	27.3	656	24.7	2510	2784	2480	2665	740	29.8	678	25.5
1010	2289	2220	5127	520	23.4	1216	23.7	2520	3091	2950	3121	780	26.5	833	26.7
1020	3942	3690	4133	870	21.1	862	20.8	2530	4945	4870	5526	1290	26.5	1361	24.6
1030	1387	1380	4098	290	21.0	998	24.4	2540	2267	2070	2258	620	29.8	754	33.4
1040	2106	1970	3461	450	22.8	343	9.9	2610	3453	3240	3541	770	23.8	961	27.2
1110	2499	2670	2529	610	22.8	158	6.4	2620	2235	2080	2768	460	22.1	840	30.4
1120	2767	2790	2938	510	18.3	734	25.0	2630	5139	4710	5479	1240	26.2	1337	24.4
1130	777	790	745	200	25.3	196	26.3	2640	7432	7230	7797	1890	26.1	2053	26.4
1140	1325	1220	1079	220	18.0	426	39.5	2710	2035	1930	4374	470	24.4	1285	29.4
1150	3958	3980	4219	880	22.1	920	21.8	2720	677	600	6865	150	25.0	1791	26.1
1160	4777	4770	5044	840	17.6	808	16.1	3010	17	310	2365	50	16.1	668	28.2
1170	3329	3350	3442	830	24.8	684	19.9								



DIST.	CHANGE	DIST.	CHANGE	DIST.	CHANGE	DIST.	CHANGE	DIST.	CHANGE
1	177	10	408	20	1334	31	-626	40	621
2	-177	11	-13	21	5426	33	-683	41	705
3	-626	12	-486	22	6183	34	794	42	8527
4	-1680	13	-146	23	1836	35	-591	46	2348
5	512	14	1191	24	-442	36	2129		
6	-376	15	7095	25	1240	37	-350		
7	-1149	16	-77	29	-280	38	-298		
8	-218	17	641	30	-330	39	483		

FIGURE: 3.1 POPULATION CHANGES BY TRAFFIC DISTRICT

district which has no significant change in population between 1961 and 1964.

Changes in Total Employment

The total employment figures by origin zone as shown on TABLE 3-I were obtained from the origin-destination surveys of 1961 and 1964. Employees under twenty one years of age are not included in the 1961 figures so adjustments must be made before comparing these figures with those of 1964. Adjustments must also be made to both the 1961 and the 1964 figures for zones having extremely high or low percentages of employment and in 1961 for large discrepancies between the census population and the origin-destination population.

The correction for the under 21 year old employees of 1961 was made by assuming 5.7 percent of the employees were under 21. This is the percentage that was obtained from the 1964 data. High or low percentage employments were adjusted by applying the percentage from the other year or by using a percentage consistent with surrounding zones. Large discrepancies between the census and origin-destination populations in 1961 were adjusted by multiplying the employment by the ratio of the census population divided by the origin destination population. The 1964 employment was also corrected by multiplying the total figure by 1.03 to allow for the fact that the origin-destination survey resulted in a 97 percent sample instead of a 100 percent sample.

Applying the above corrections to the total employment figures of 79,830 in 1961 and 94,011 in 1964 results in an increase in total

employment from 86,200 to 98,372 or about 14 percent. This increase is greater than the 10.6 percent increase of population indicating that employment opportunities were greater in 1964.

Employment Changes in the Central Business District

Since this study concerns the home-to-work journey destined to the Central Business District, changes in employment in this area have a significant effect on the study. Increased employment in this area could cause an overcrowding of the available parking and increased traffic congestion in the downtown area, resulting in an increase in the attractiveness of public transit. On the other hand outward movement of the residential location of the workers could result in a trend away from transit if suitable service was not provided.

TABLE 3-II outlines the breakdown of Central Business District employees by origin zone for both 1961 and 1964 giving the number of employees and the percentage of total employees from each zone. Also included in the table is a column for adjusted employment to show corrections for zones having an unreasonably high or low percentage of persons employed and for the difference between the census population and the origin-destination population in 1961. The figures were not adjusted for the number of employees under 21 years of age and for the 97 percent sample of 1964 as the validity of applying these corrections on a zone to zone basis would be questionable.

The percentage of the employees that work in the Central Business

TABLE 3-II
CENTRAL BUSINESS DISTRICT EMPLOYMENT
BY ORIGIN ZONE

Origin Zone	OD Emp	1961		OD Emp	1964		Origin Zone	OD Emp	1961		OD Emp	1964	
		% of Total ₁	Adj Emp ₂		% of Total ₁	Adj Emp ₂			% of Total ₁	Adj Emp ₂		% of Total ₁	Adj Emp ₂
CBD	1700	70.5	1955	1488	60.0		1310	570	29.9	550	623	26.8	
110	210	29.2	248	175	26.9		1320	280	22.6	289	472	25.5	
120	430	37.1	440	226	21.6		1330	140	25.0	136	342	25.4	
140	310	38.8	320	211	37.1		1340	250	23.4	242	510	25.5	
150	350	45.5	380	301	39.4		1410	100	22.7	100	314	24.5	
210	400	43.6	730	495	36.5		1420	210	34.4	217	505	26.4	
220	120	26.2	241	235	23.6		1430	50	13.5	60	145	19.7	
230	580	37.7	467	466	37.5		1440	80	17.8	77	163	19.7	
240	90	37.5	100	92	33.1		1520	250	22.9	276	310	22.3	
250	200	26.3	217	222	27.8		1540	270	30.7	270	259	24.4	
260	230	27.0	231	267	13.1		1550	0	0	21	31	29.1	18
310	460	46.0	520	424	43.6		1620	270	32.1	270	303	22.7	
320	480	52.1	492	472	44.3		1620	260	29.6	260	311	25.8	
330	340	51.5	359	361	41.0		2010	330	35.5	338	220	25.4	
340	340	49.3	342	313	44.5		2020	260	24.5	316	237	26.8	
410	240	40.7	241	226	36.2		2110	570	32.8	570	517	30.2	
430	390	39.8	416	302	33.5		2120	140	30.4	140	116	23.3	
440	480	49.5	472	395	33.9		2130	360	42.4	347	391	33.4	
510	630	31.2	650	575	29.5		2140	160	27.6	203	153	27.6	
520	470	32.4	453	473	30.5		2220	200	41.7	263	154	41.2	
540	290	26.3	333	237	17.7		2230	300	29.1	314	228	31.0	
550	190	24.4	168	199	22.7		2250	0	--	--	60	35.1	
560	540	37.5	579	367	30.7		2310	400	29.0	423	318	28.3	
710	180	25.4	187	194	27.2		2320	130	21.6	134	136	21.5	
720	430	26.7	459	541	30.7		2330	490	34.7	348	283	29.8	
730	690	46.9	685	541	39.5		2340	140	37.8	266	246	27.3	
810	320	25.8	303	361	23.2		2350	110	26.2	116	105	22.5	
820	350	34.0	370	72	29.4	320	2360	20	15.4	31	86	19.1	
830	180	27.2	171	223	34.2		2370	130	32.4	124	197	26.2	
840	70	50.0	66	94	39.0		2410	250	20.8	240	224	23.1	
860	410	29.5	392	349	31.4		2420	200	27.8	194	186	28.5	
870	540	34.4	509	499	32.0		2430	240	39.1	256	203	27.6	
880	510	38.3	567	623	41.0		2440	160	29.1	260	270	26.4	
910	300	58.9	332	306	50.8		2450	0	--	121	115	27.8	
920	380	46.3	380	337	36.9		2460	250	27.2	278	260	24.4	
930	580	37.7	493	595	37.4		2470	240	21.8	253	301	23.1	
940	120	33.3	230	248	37.7		2510	290	39.2	325	254	37.4	
1010	150	28.8	155	349	33.7		2520	260	33.4	272	268	32.2	
1020	190	21.8	203	187	21.7		2530	430	33.4	436	470	34.5	
1030	120	41.3	291	285	23.5		2540	240	38.6	263	216	28.7	
1040	190	42.2	203	125	36.4	287	2610	280	36.4	298	306	31.8	
1110	80	13.1	171	54	34.2	197	2620	140	30.4	150	307	36.6	
1120	150	29.4	149	168	22.9		2630	420	33.9	458	466	34.9	
1130	40	20.0	39	43	21.9		2640	740	39.2	760	658	32.0	
1140	10	4.5	72	145	34.0		2710	130	27.7	137	403	31.4	
1150	180	20.5	179	216	23.5		2720	70	46.7	79	568	31.7	
1160	200	23.8	200	166	20.6		3010	20	40.0	1	197	29.5	
1170	230	27.7	229	164	24.0		3010	20	40.0	1	197	29.5	
Total								27,000		28,873	28,874		29,364

1 Percentage of total employees living in the zone who are employed in the CBD

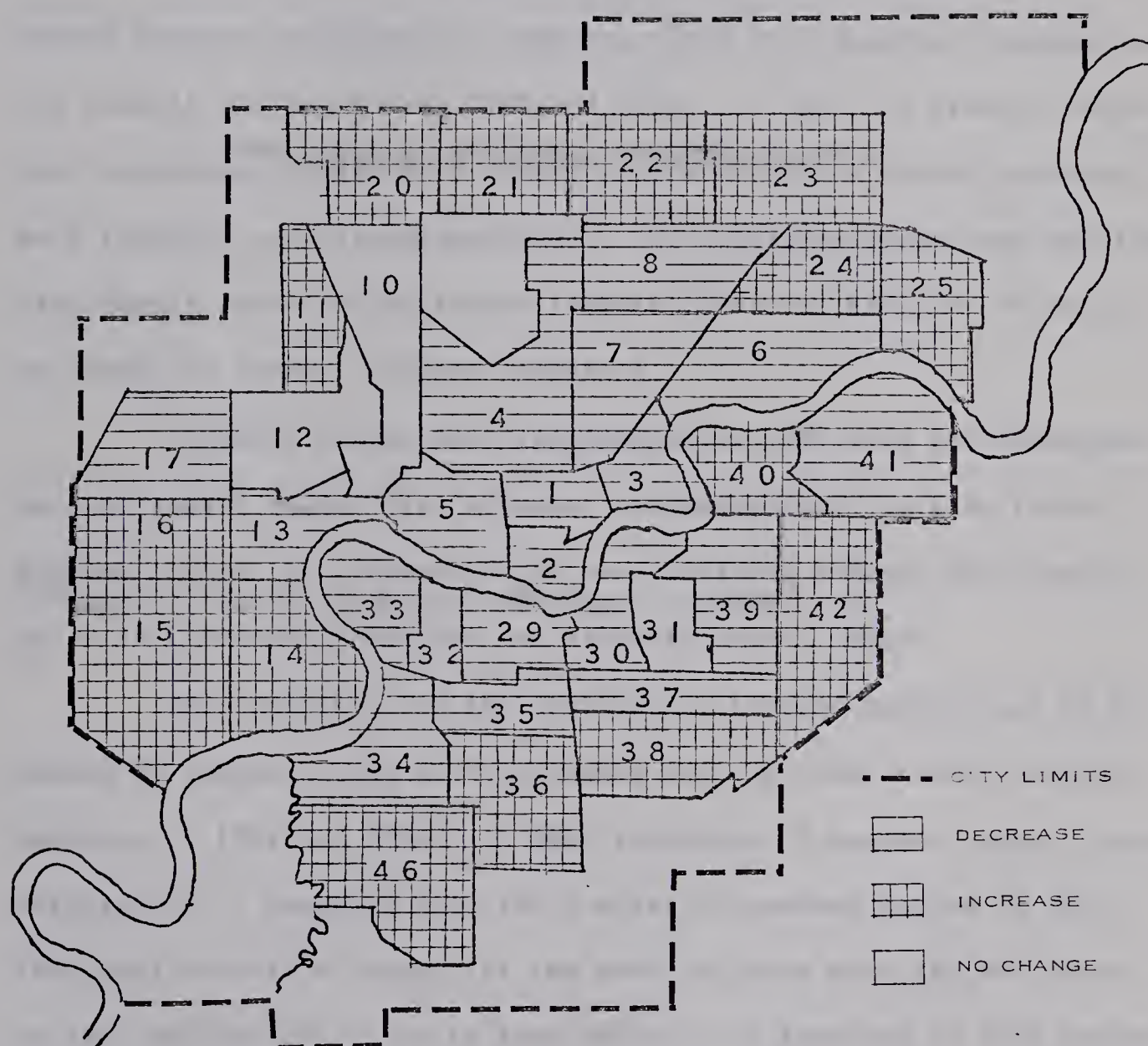
2 These figures were adjusted for inconsistencies in the employment figures

District varies from twenty to about seventy with most of the zones falling in the twenty-five to forty percent range. With the exception of the Central Business District itself and a few of the close-in zones there seems to be no preference as to home location for employees who work in the Central Business District.

Total employment in the Central Business District shows an increase of 1.7 percent between 1961 and 1964. However adjustments for the workers under 21 years of age and for the three percent omitted in the 1964 survey could cause the difference to actually be a decrease of up to three percent. Since the 1961 figures are based on a ten percent sample these differences are insignificant and the employment in the Central Business District can be considered as unchanged during the three years.

Although there was no change in the number of Central Business District employees, there was an outward shift in the residential location of approximately ten percent of the employees as illustrated on FIGURE 3-2. This figure shows a decrease in CBD employees in the inner districts and an increase in the outer districts with the exception of district eighteen in the west end and district forty-one in the east end. The probable reason for decreased CBD employees in these districts is the proximity of the developing industrial area north and west of district eighteen and the refinery district adjacent to district forty-one. These areas have attracted employees away from the Central Business District.

The number of Central Business District employees living in the peripheral zones increased 34 percent during the three years with



DIST. CHANGE DIST. CHANGE DIST. CHANGE DIST. CHANGE DIST. CHANGE

1	-467	10	3	20	256	31	-6	40	165
2	-188	11	30	21	474	33	-109	41	-94
3	-209	12	3	22	502	34	-28	42	755
4	-138	13	-69	23	168	35	-103	46	196
5	-206	14	120	24	23	36	37		
6	-342	15	256	25	84	37	-77		
7	-276	16	122	29	-197	38	34		
8		17	-62	30	-77	39	-88		

FIGURE 3.2 CHANGES IN CENTRAL BUSINESS DISTRICT EMPLOYMENT
BY TRAFFIC DISTRICT

41.7 percent of the people employed in the Central Business District living in these zones in 1964.

Transportation Changes

Between 1961 and 1964 there were no major changes in the street network in Edmonton. However, there were numerous changes in the transit routing during 1962 and 1963. In 1961 the transit routes were operating chiefly as a radial system with some routes operating both radially and circumferentially. The outlying areas were serviced with feeder routes which forced transit riders to transfer in order to reach the Central Business District.

Transit routes were reorganized in 1962 with the establishment of radial routes with separate circumferential or ring routes. Express service was introduced to some outlying areas at this time in order to eliminate transfers and decrease travel times.

An indication of the increase in transit service can be obtained by comparing the route mileages and the total monthly vehicle mileages of 1961 and 1964. In 1964 the miles of one-way transit route totalled 157.5 compared with 100.7 miles of one-way routes in 1961. The total vehicle mileages for the month of June were 465,649 miles in 1961 and 562,675 miles in 1964 which is an increase of 20.8 percent.

The other transit change during this period was a fare increase in 1962 and the introduction of monthly bus passes at ten dollars per month. Adult fares were increased from 15 cents to 20 cents for single tickets and from 8 tickets to 7 tickets for one dollar. The single children's fare remained at 10 cents but the number

of tickets for 25 cents was reduced from six to four. Since costs are not being considered in this study, the effects of these increases will not be measured. However, it is felt that the fare increase would have little effect since the fare is still relatively low compared to the parking rates in the Central Business District.

CHAPTER IV

ORIGIN-DESTINATION DATA

Since origin-destination data often forms the basis of a transportation study, this data should be as complete and as accurate as possible. The most reliable origin-destination information is obtained through a home interview at as many homes as economics and staff availability will permit.

The basic assumption of an origin-destination survey is that travel patterns can be determined by interviewing only a portion of the people at a particular time of the year. Therefore it must be remembered that the travel patterns obtained from such a survey are those in existence at the time the survey was carried out and could be quite different at different times of the year.

In Edmonton the major origin-destination surveys of both 1961 and 1964 were conducted in conjunction with the civic census. This census is carried out in most Alberta centers every year in order to keep an up-to-date account of populations for the Provincial grants to municipalities. The census in Edmonton determines the number of people over twenty-one years old, the number under twenty-one and the ages of all pre-school children. This information is totalled for each of the 254 polling districts in the City. Since the traffic zone boundaries were selected to coincide with the boundaries of the polling districts, the

data obtained from the census could be quite easily applied to traffic zones.

1961 Origin-Destination Surveys

Three surveys were conducted for collection of origin-destination data in 1961. The main survey, which was conducted with the census, was an interview of all employees over the age of twenty-one so that detailed information on the home-to-work journey could be obtained. Answers to the questions were recorded in the census books so the information had to be extracted manually and coded on to computer cards as shown on FIGURE 4-1. In order to facilitate the extraction of data, the origin-destination data was taken out of the books as a 10 percent sample which decreases the accuracy of the origin-destination results.

The second origin-destination survey conducted was an interview with twenty-five percent of the transit patrons. FIGURE 4-2 outlines the information obtained from this survey as well as the card nomenclature used in coding the information. The origin zone and destination zone recorded in columns 21 to 27 were those used at the beginning of the METS and were later changed. Columns 50 to 57 contain the origin and destination zones as were eventually used in the METS.

A home interview at one percent of the dwelling units was also conducted in 1961 to obtain information on trips for all purposes and to compare to the 10 percent sample for accuracy. The method of tabulation of this data on the IBM cards is shown on FIGURE 4-3. Columns 1 to 21 contain general survey and household information which would be the same

FIGURE 4-1 CARD NOMENCLATURE FOR THE 1961

ORIGIN-DESTINATION SURVEY

Column	Identification
1,2,3,4	Zone of Residence
5	Type of Sample
6 to 19	Blank
20,21	Population of D.U.
22	Occupation RE: Land Use
23,24,25,26	Zone of Employment
27,28	Number of Vehicles per D.U.
29	Mode of Travel
30	Type of Dwelling
31	Remarks
32,33	Line Number - Coding Sheets
34,35	Page Number - Coding Sheets
36,37	Survey Number 01

FIGURE 4-2 CARD NOMENCLATURE FOR THE 1961

EDMONTON TRANSIT SYSTEM SURVEY

Column	Identification
1,2	Route
3	Section of Route
5,6	Month Interviewed
7	Day of week
9,10	Time Interviewed (Hour)
11	Time Interviewed (Quarter of hour)
13	Sex
14,15	Age
17	Walking Blocks from Bus
18	Walking Blocks to Bus
19	Number of Cars in Family
21,22,23	Zone of Origin
25,26,27	Zone of Destination
29	Change in Mode of Travel
30	Purpose of Trip (From)
31	Purpose of Trip (To)
34	Trips Per Day or Week
35	Number of Trips Per Period
38	Car Availability
39	Fare Paid
41	Transfer From or To
42,43	Route Transferring From or To
50 to 53	METS Origin Zone
54 to 57	METS Destination Zone

FIGURE 4-3 CARD NOMENCLATURE FOR THE 1961

ONE PERCENT HOME INTERVIEW

Column	Identification
1,2	Survey No.
3,4,5	Card No.
6,7,8,9	Zone No. (Home)
10,11,12	Sample No.
13	Dwelling Unit Type
14	Date of Travel
15,16	Number of Persons
17	Persons Employed
18	No. of Cars
19	Years at Present Address
20	Last Place of Residence
21	Income
22	Person Number
23,24,25,26	Origin Zone
27,28,29,30	Destination Zone
31	Land Use "From"
32	Land Use "To"
33,34	Purpose of Trip Code
35	From Home
36,37,38	Time of Start
39	Mode Code
40	No. in Car

for all persons in a household whereas columns 22 to 50 contain the trip information which is completed for each member in the household making a trip. The column on income is the annual family income to the nearest one thousand dollars. Data from this survey was not analyzed for the present study.

1964 Origin-Destination Survey

Although the 1964 origin-destination survey was also conducted with the census, the method of obtaining data and the type of information obtained was much better than for the 1961 survey. The information was recorded in separate books of IBM mark-sense cards such as shown on FIGURE 4-4 by marking the appropriate answers with a pen or pencil. Polling district numbers were recorded on the outside of each book so the origin zones corresponding to the polling district could be gang punched. Each card had to be coded for destination zone and mark-sensed after the field collection was completed. By using this method of data collection a 97 percent sample was obtained after cards which could not be coded were discarded.

Following the data collection the mark sense cards were analyzed and compiled onto summary cards which contained the total information for each zone to zone movement and for each origin zone. Four cards were required for each summary and the zone to zone cards were differentiated from the zone total cards by the use of "ORIG-DEST" or "ORIG-TOT" in columns 67 to 75. Card nomenclature for the summary cards is shown on FIGURE 4-5 for card number 1 and on FIGURE 4-6 for card numbers 2,3 and 4.

FOR OFFICE USE ONLY										ITEM 1	
DISTRICT M.E.T.S.		ORIGIN ZONE M.E.T.S.		DESTINATION ZONE M.E.T.S.		LOCATION OF EMPLOYMENT					
C0	D0	C0	D0	C0	D0	C0	D0	C0	D0		
C1	D1	C1	D1	C1	D1	C1	D1	C1	D1		
C2	D2	C2	D2	C2	D2	C2	D2	C2	D2		
C3	D3	C3	D3	C3	D3	C3	D3	C3	D3		
C4	D4	C4	D4	C4	D4	C4	D4	C4	D4		
C5	D5	C5	D5	C5	D5	C5	D5	C5	D5		
C6	D6	C6	D6	C6	D6	C6	D6	C6	D6		
C7	D7	C7	D7	C7	D7	C7	D7	C7	D7		
C8	D8	C8	D8	C8	D8	C8	D8	C8	D8		
C9	D9	C9	D9	C9	D9	C9	D9	C9	D9		
1	2	3	4	5	6	7	8	9	10		

1964 EDMONTON CENSUS

ITEM 1 - WRITE CLEARLY THE NEAREST STREET AND AVENUE INTERSECTION OR THE NAME OF BUILDING AT WHICH THE PERSON IS EMPLOYED.

ITEM 2 - MARK THE CORRESPONDING BUBBLE (SEE BELOW) THAT INDICATES THE TIME NEAREST WHICH THE EMPLOYEE STARTS WORK (A.M. ONLY). MARK "OTHER" IF HE STARTS AFTER 9.30 A.M.

ITEM 3 - MARK "FIRST" FOR THE FIRST CARD ONLY AT EACH HOUSEHOLD. MARK "OTHERS" FOR CARDS OF REMAINING PEOPLE THERE WHO ARE EMPLOYED.

ITEM 4 - MARK A NUMBER IN THIS COLUMN IF YOU MARKED "FIRST" IN ITEM 3, OTHERWISE LEAVE BLANK

ITEM 5, 6 & 7 - MARK ONE IN EACH COLUMN

HOW TO MARK A BUBBLE: A SINGLE STROKE THROUGH BUBBLE

BEFORE: AFTER:

ITEM 1	ITEM 2	ITEM 3	ITEM 4	ITEM 5	ITEM 6	ITEM 7	ITEM 8	ITEM 9	ITEM 10
STARTS WORK	7.15	7.30	7.45	8.00	8.15	8.30	8.45	9.00	9.15
WATCH LAST DAY'S WORK FOR THIS HOUSEHOLD									
CLOSER DAYS THAN LAST HOUSEHOLD									
ITEM 5									
ITEM 6									
ITEM 7									
ITEM 8									
ITEM 9									
ITEM 10									

12MKE7470

FIGURE 4.4 1964 MARK SENSE CARD

FIGURE 4-5 CARD NOMENCLATURE FOR THE 1964

SUMMARY CARD NUMBER ONE

Column	Data Contained
1 to 5	Number of Auto Drivers
6 to 10	Number of Auto Passengers
11 to 15	Number of Bus Patrons
16 to 20	Number of Walking Employees
21 to 25	Number of Employees by Other Modes
26 to 30	Total Employees for this Zone to Zone Movement or Zone Total of Employees
31 to 35	Number of Employees Employed Full Time
36 to 40	Number of Employees Employed Part Time
41 to 45	Number of Employees 21 years of age and over
46 to 50	Number of Employees under 21 year of age
51 to 55	Number of Dwelling Units for each Zone-Zone Movement or for each Zone Total
56 to 59	Origin Zone (METS)
60 to 63	Destination Zone (METS) Note: for the Zone Total Cards these four digits are meaningless and should be ignored
64 to 65	Origin District (METS)
66	Blank
67 to 75	Identifier for Type of Summary Card (Orig-Dest) for Zone-Zone Totals (Orig-Tot(bl.)) for Zone Grand Totals
76 to 77	Destination District Note: for the Zone total cards these two digits are meaningless and should be ignored
78	Blank
79	Blank in Zone-Zone Totals
	Contains Zero for Zone Totals
80	Card Number (1)

FIGURE 4-6 CARD NOMENCLATURE FOR THE 1964

SUMMARY CARDS TWO, THREE AND FOUR

	Column	Data Contained
Card 2	1 to 50	Totals by all modes of travel by time that employee must start work
	1 to 5	Start Work at 7:15 a.m.
	6 to 10	Start Work at 7:30 a.m.
	11 to 15	Start Work at 7:45 a.m.
	16 to 20	Start Work at 8:00 a.m.
	21 to 25	Start Work at 8:15 a.m.
	26 to 30	Start Work at 8:30 a.m.
	31 to 35	Start Work at 8:45 a.m.
	36 to 40	Start Work at 9:00 a.m.
	41 to 45	Start Work at 9:15 a.m.
	46 to 50	Start Work at 9:30 a.m.
	51 to 55	Blank
	56 to 79	Same data as for Card 1
Card 3	80	Card Number (2)
	1 to 50	Totals by "Auto Driver" mode only, by time that employee must start work - Breakdown of Columns same as for Card Number 2 except Column 80
Card 4	80	Card Number (3)
	1 to 50	Totals by "Bus Patron" mode only, by time that employee must start work - Breakdown of Columns same as for Card Number 2 except for Column 80
	80	Card Number (4)

It will be noted that car ownership figures were not included on the summary cards so it was decided that the time required to obtain these figures from the original data cards would not warrant their extraction for the present study. The 1964 data was far more complete than that of 1961 and being a much larger sample the information contained in this survey is more suitable for analysis of smaller zones. This type of analysis is important for transit studies and for comparing mode splits in different areas of the Central Business District.

Analysis of the Origin-Destination Data

Computer analysis was used to obtain the zone-to-zone mode splits for both 1961 and 1964. The other information which was required for this study was obtained in the form of computer print-outs from previous analyses of the origin-destination data.

The Central Business District was divided into three areas for the mode split analysis. These areas consisted of: zones 0010 + 0020 which is the main office and commercial center as well as the location of the City offices; zones 0030 + 0040 which includes the warehousing and wholesale areas along with a number of retail car sales establishments; and zone 0060 which is the location of the provincial government offices. The other two zones in the Central Business District were not considered because the number of trips destined to these zones was very small.

Tabulations Obtained from Previous 1961 Analyses

Tabulations of some of the results of the analysis from the 1961 10 percent sample were obtained from the Edmonton Transit System. The information from these tabulations which was used in this study included figures of population, number of vehicles and number of dwelling units for each origin zone.

The analysis of the ETS survey carried out in 1961 was completely tabulated. The tabulations of the number of transit trips versus the walking distance for home-to-work trips, were obtained from the ETS and were used in calculating the average walking distances to be used in the travel time computations. The average walking distance in the origin zone was calculated from the weighted average of trips versus walking distance for all Central Business District destinations. Since most origin zones are served only by one bus route the average of the distance for all downtown zones should be more realistic. Many of the origin zones had no figures on walking distances or had figures which were unrealistic. Therefore the average walking distance was selected by inspection of the zone size and location of bus routes. Walking distances obtained from this survey were also used for most zones in 1964 as no data of walking distances were available for that year.

1961 Mode Split Calculations

Computation of mode splits and Central Business District employment for 1961 was based on the data obtained from the 10 percent sample. A computer analysis was carried out with the output appearing as shown on FIGURE 4-7. The figures for population, dwelling units, total cars and cars per dwelling unit are of no value since the analysis was done only for the Central Business District destinations. Following the output of the zone-to-zone mode splits, the trips by each mode were totalled for the seven destination zones and the mode split by destination zone was computed.

TABLE 4-I contains the number of trips and the mode split from each origin zone to the three Central Business District destination zones. The mode splits in this table were calculated as the number of employees travelling by transit divided by the total number of employees and expressed as a percentage. Inclusion of walking trips and other trips in the denominator had very little effect on the mode split of all but the zones close to the Central Business District. For these zones the mode split was calculated as the number of transit patrons divided by the sum of the transit patrons and the car users. TABLE 4-II shows the effect of excluding the walking and other trips for all zones in which the absolute mode split increase was greater than 5 percent.

Origin Zone	Dest. Zone	Driver	Automobile		Bus	Walk	Other	Total Emp.	Pop.	Dwelling Units	Total Cars	Cars Per day	Mode Split
			Pass.	Total									
440	10	20	10	30	20	0	20	70	170	6	3	0.50	28
440	20	170	30	200	40	0	20	270	780	21	19	0.90	14
440	10 + 20	190	40	230	60	0	40	340	950	27	22	0.81	17
440	30	20	0	20	0	0	0	20	130	2	5	2.50	0
440	40	40	20	60	0	0	10	70	200	5	4	0.80	0
440	30 + 40	60	20	80	0	0	10	90	330	7	9	1.29	0
440	50	0	0	0	10	0	0	10	0	0	0	0.00	100
440	60	20	0	20	0	0	0	20	80	2	3	1.50	0
440	70	20	0	20	0	0	0	20	80	2	2	1.00	0
440	Total	290	60	350	70	0	50	480	1440	38	36	0.95	14

FIGURE 4-7 SAMPLE COMPUTER OUTPUT FOR 1961 MODE SPLIT ANALYSIS

TABLE 4-I

1961 MODE SPLITS

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ORIGIN ZONE	DESTINATION ZONES						ORIGIN ZONE	DESTINATION ZONES					
	0010 + 0020 M.S., TRIPS	0030 + 0040 M.S., TRIPS	0060 M.S., TRIPS	0010 + 0020 M.S., TRIPS	0030 + 0040 M.S., TRIPS	0060 M.S., TRIPS		0010 + 0020 M.S., TRIPS	0030 + 0040 M.S., TRIPS	0060 M.S., TRIPS	0010 + 0020 M.S., TRIPS	0030 + 0040 M.S., TRIPS	0060 M.S., TRIPS
110	30	130	50	40	75	40	1310	23	430	14	70	14	70
120	34	290	50	60	20	50	1320	16	250	0	30	--	--
140	47	230	50	60	100	10	1330	37	80	0	10	33	30
150	37	290	100	10	33	30	1340	33	150	0	40	0	40
210	28	280	14	70	50	20	1410	20	100	--	--	--	--
220	38	130	100	10	25	80	1420	35	170	50	20	0	20
230	48	390	22	90	25	40	1430	66	30	0	10	0	10
240	66	60	--	--	33	30	1440	33	60	0	20	--	--
250	12	160	0	40	--	--	1520	47	210	0	30	--	--
260	35	170	40	50	--	--	1540	41	170	16	60	0	20
310	42	190	0	100	0	130	1550	--	---	--	--	--	--
320	51	270	37	80	8	120	1620	21	140	20	50	0	30
330	52	210	25	40	37	80	1630	40	200	0	20	25	40
340	55	200	50	100	33	30	2010	66	180	50	80	25	40
410	52	190	50	40	0	10	2020	31	190	0	20	25	40
430	48	310	20	50	0	30	2110	52	380	55	90	37	80
440	17	340	0	90	0	20	2120	55	90	0	30	0	20
510	55	490	57	70	20	50	2130	33	240	25	80	50	40
520	53	320	71	70	100	60	2140	50	80	50	60	50	20
540	47	170	25	40	14	70	2220	0	150	0	30	0	20
550	41	120	50	20	80	50	2230	26	190	16	60	0	50
560	45	440	40	50	33	30	2250	--	---	--	--	--	--
710	16	120	100	20	25	40	2310	48	270	37	80	25	40
720	54	220	40	100	30	100	2320	54	110	0	10	100	10
730	33	420	29	170	22	90	2330	35	340	20	50	22	90
810	27	220	20	50	0	20	2340	60	90	33	30	0	20
820	31	220	0	90	33	30	2350	0	100	0	10	--	--
830	50	100	0	50	0	30	2360	--	---	0	10	0	10
840	20	50	--	--	0	20	2370	36	110	--	--	0	20
860	37	270	50	60	0	60	2410	43	160	20	50	25	40
870	25	390	0	50	0	70	2420	42	140	0	10	25	40
880	42	400	25	40	33	60	2430	30	200	0	30	--	--
910	4	250	0	10	0	10	2440	40	100	25	40	0	20
920	42	280	0	30	33	30	2450	--	---	--	--	--	--
930	8	360	0	100	25	80	2460	36	190	100	10	20	50
940	0	90	0	30	--	--	2470	50	140	16	60	50	40
960	0	10	50	20	--	--	2510	20	150	33	60	42	70
1010	0	90	0	30	0	30	2520	27	180	0	20	16	60
1020	9	110	0	30	40	50	2530	28	210	33	90	8	120
1030	0	70	0	10	0	20	2540	40	100	28	70	16	60
1040	0	120	0	10	0	50	2610	45	200	0	10	0	40
1110	50	40	0	10	33	30	2620	58	120	0	10	0	10
1120	22	90	0	30	0	20	2630	31	220	7	140	0	50
1130	50	20	--	--	50	20	2640	38	360	31	160	5	180
1140	--	---	0	10	--	--	2710	14	70	0	20	0	30
1150	33	90	0	60	--	--	2720	0	30	--	--	25	40
1160	13	150	0	20	0	10	3010	0	20	--	--	--	--
1170	0	120	0	20	0	90							

1 - Mode split in percent

TABLE 4-II
THE EFFECT OF THE WALKING AND OTHER TRIPS
ON THE 1961 MODE SPLITS

Origin Zone	0010 + 0020		Destination Zones 0030 + 0040		0060	
	Including Walking	Excluding Walking	Including Walking	Excluding Walking	Including Walking	Excluding Walking
110	30	67	50	67	75	75
120	34	62	50	60	20	25
140	47	92	50	75	100	100
150	37	65	100	100	33	50
210	28	50	14	15	50	50
230	48	53	22	40	25	25
260	35	43	40	67	--	--
310	42	57	0	0	0	0
320	51	54	37	50	8	14
330	52	55	25	25	37	43

The effect of the 10 percent sample on the mode split computations is very noticeable in the results of zones 0030 + 0040 and 0060 with the actual number of trips sampled being only one tenth of the number shown on TABLE 4-I. For destination zone 0030 + 0040 forty-eight of the ninety-five origin zones have mode splits calculated from three or less trips and would therefore have to be discarded in establishing modal split relationships. Another seventeen zones have mode splits calculated from four or five trips making the results of these mode splits very unreliable. With only seven zones having mode split calculations made from ten or more trips it is doubtful that modal split relationships can be established for this zone. The comparable figures for destination

zone 0060 are fifty-one zones with three or less trips, twenty-two with four or five trips and only five with ten or more trips. Thus the 1961 modal split relationships for destination zones 0030 + 0040 and 0060 will have little significance if they can be determined.

The total employment and the mode split for each downtown destination zone is shown on TABLE 4-III. Mode splits are shown for the computations both including and excluding the walking and other trips with the difference being about 4 percent.

TABLE 4-III

1961 MODE SPLITS BY DESTINATION ZONE

Dest. Zone	Total Employment	Mode Splits	
		Including Walking	Excluding Walking
0010	8340	34	38
0020	9640	34	37
0010 + 0020	17,980	34	38
0030	1200	16	20
0040	3200	25	29
0030 + 0040	4400	23	27
0050	640	23	27
0060	4090	17	22
0070	410	17	19

The overall mode split is fairly high for zone 0010 + 0020 but decreases quite rapidly for the other two downtown zones. Probable reasons for the lower mode splits in zones 0030 + 0040 and 0060 are the availability of more parking and the fact that the transit service is oriented toward zones 0010 + 0020 making transit less convenient in

the other zones.

1964 Mode Split Calculations

The computer analysis of the 1964 data was made on the ORIG-DEST summary cards with Central Business District destination. Output was contained in four printouts, the first being mode split by origin zone for each of the CBD destination zones as shown on FIGURE 4-8. The second output contained employment and mode splits by destination zone and the third and fourth contained mode splits by time of arrival, both by origin zone and by destination zone.

TABLE 4-IV contains the number of trips and the mode split from each origin zone to each of the three CBD destination zones being used in this study. Since the mode splits in this analysis were calculated in the same manner as those of 1961, corrections had to be made for zones in which the inclusion of the walking and other trips had a significant effect on the mode splits. These corrections are outlined on TABLE 4-V.

TABLE 4-V

THE EFFECT OF THE WALKING AND OTHER TRIPS ON THE 1964 MODE SPLITS

Origin Zone	Destination Zones					
	0010 + 0020		0030 + 0040		0060	
	Including Walking	Excluding Walking	Including Walking	Excluding Walking	Including Walking	Excluding Walking
110	41	62	76	87	46	52
120	55	66	68	68	46	50
140	42	61	57	58	31	33
150	51	63	41	45	50	55
210	40	51	28	38	26	31
310	42	61	8	24	2	13
320	56	66	15	34	18	29

Orig. Zone	Dest. Zone	Auto Driv.	Auto Pass.	Bus	Walk	Other	Tot Emp.	Full Time	Part Time	Over 21	Percentage				Mode Splits		
											Under 21	Under 21	Part Time	Under 21	Auto Driv.	Auto Tot.	Bus
440	10	63	9	61	0	0	133	131	2	125	8	6	1	7	47	54	45
440	20	50	10	65	0	1	126	123	3	117	9	7	2	9	39	47	51
440	30	20	3	4	0	0	27	27	0	23	4	14	0	14	74	85	14
440	40	24	4	9	0	0	37	37	0	34	3	8	0	8	64	75	24
440	50	4	2	4	0	0	10	10	0	9	1	10	0	10	40	60	40
440	60	28	7	22	0	0	57	56	1	54	3	5	1	7	49	61	38
440	70	3	1	1	0	0	5	5	0	5	0	0	0	0	60	80	20
440	Total	192	36	166	0	1	395	389	6	367	28	7	1	8	48	57	42

FIGURE 4.8 SAMPLE COMPUTER OUTPUT FROM THE 1964 MODE SPLIT ANALYSIS

TABLE 4-IV

1964 MODE SPLITS

ORIGIN ZONE	DESTINATION ZONES						ORIGIN ZONE	DESTINATION ZONES					
	0010 + 0020 M.S., TRIPS	0030 + 0040 M.S., TRIPS	0060 M.S., TRIPS	0010 + 0020 M.S., TRIPS	0030 + 0040 M.S., TRIPS	0060 M.S., TRIPS		0010 + 0020 M.S., TRIPS	0030 + 0040 M.S., TRIPS	0060 M.S., TRIPS	0010 + 0020 M.S., TRIPS	0030 + 0040 M.S., TRIPS	0060 M.S., TRIPS
110	41	129	76	17	46	26	1310	38	408	23	117	23	81
120	55	158	68	28	46	26	1320	41	303	30	90	30	69
140	42	142	57	37	31	29	1330	40	227	22	60	29	48
150	51	210	41	51	50	34	1340	40	339	17	83	22	63
210	40	340	28	82	26	63	1410	38	222	24	41	29	41
220	55	160	30	33	38	34	1420	43	331	26	86	27	76
230	51	285	12	82	16	83	1430	48	80	18	17	36	44
240	42	62	30	10	12	16	1440	42	106	29	31	40	20
250	26	143	14	36	27	40	1520	50	212	31	51	42	40
260	60	185	37	46	30	26	1540	54	175	16	49	14	28
310	42	178	8	92	2	128	1550	38	54	11	18	12	8
320	56	276	15	97	18	94	1620	54	183	21	72	42	35
330	44	245	31	58	34	52	1630	46	204	25	56	35	48
340	51	202	40	65	44	43	2010	44	135	16	25	18	49
410	44	158	44	32	32	31	2020	40	140	21	38	22	47
430	49	220	32	44	24	33	2110	64	337	36	81	48	85
440	49	259	28	64	38	57	2120	49	87	33	15	75	8
510	65	379	48	85	43	100	2130	54	252	25	63	42	59
520	63	328	34	73	40	59	2140	53	102	40	25	36	19
540	44	162	22	27	28	38	2220	10	105	3	34	7	13
550	52	132	45	33	34	26	2230	34	148	22	32	7	41
560	52	232	31	71	49	57	2250	9	35	0	11	10	10
710	48	128	18	39	62	24	2310	49	180	27	55	18	71
720	57	323	27	98	37	106	2320	62	92	50	18	30	23
730	46	343	31	96	41	82	2330	41	180	12	50	20	49
810	32	206	23	64	18	86	2340	54	146	38	34	34	58
820	18	45	8	13	30	13	2350	49	72	36	11	30	20
830	28	133	13	40	29	48	2360	33	49	13	16	0	19
840	28	57	19	16	6	16	2370	35	110	12	34	6	49
860	39	202	29	66	26	61	2410	64	133	28	36	47	46
870	32	309	19	97	11	85	2420	69	130	37	27	46	28
880	28	391	15	91	18	127	2430	43	139	27	30	26	26
910	9	230	7	45	7	28	2440	48	164	15	59	26	41
920	35	226	27	62	28	39	2450	43	72	30	23	15	19
930	18	363	6	109	10	110	2460	57	154	16	45	16	54
940	8	166	4	51	4	21	2470	52	195	21	47	34	47
960	--	---	--	--	--	--	2510	37	170	10	41	25	35
1010	16	195	8	79	3	66	2520	43	160	17	42	19	62
1020	35	103	18	44	18	32	2530	46	322	25	56	15	73
1030	21	173	2	53	4	50	2540	52	140	16	25	27	44
1040	0	64	0	32	0	23	2610	42	186	27	52	25	58
1110	19	31	5	21	0	1	2620	48	222	36	42	37	32
1120	38	93	32	37	12	33	2630	22	290	10	73	16	86
1130	48	21	64	11	57	7	2640	36	402	18	113	10	128
1140	9	90	4	24	0	23	2710	29	238	13	86	10	64
1150	23	127	9	53	13	29	2720	32	342	9	107	12	101
1160	34	100	13	39	31	22	3010	14	97	0	29	10	64
1170	21	90	15	39	13	29							

1 Mode split in percent

The fact that the 1964 survey was almost a 100 percent sample has decreased the effect of including the walking trips in the denominator of the mode split calculation. In comparing the changes in TABLE 4-V with those of TABLE 4-II it is seen that the largest increase in mode split in 1964 was 21 percent whereas most of the 1961 zones had increases greater than 20 percent with the largest being 45 percent. The number of zones with increases of greater than 5 percent was nine for 1961 compared with seven for 1964.

TABLE 4-VI outlines the number of employees and the mode split for each of the CBD destination zones. Mode splits are shown both including and excluding the walking and other trips with the increase in mode split being about 3 percent.

TABLE 4-VI

1964 MODE SPLITS BY DESTINATION ZONE

Dest. Zone	Total Employment	Mode Splits	
		Including Walking	Excluding Walking
0010	9,574	40	43
0020	9,003	39	42
0010 + 0020	18,577	40	42
0030	1,723	17	19
0040	3,350	23	25
0030 + 0040	5,073	22	23
0050	597	24	27
0060	4,989	22	25
0070	301	17	19

In comparing the mode splits by destination zone in TABLE 4-VI (1964) those in TABLE 4-III (1961), it can be seen that the percentage of people using transit increased significantly over three years. The increases took place in zones 0010 + 0020 and 0060 which were the two zones most affected by the improved transit service, indicating that the improvements in the transit system did have an effect on the mode split to the Central Business District as a whole.

In the analysis of mode split by time of arrival, only the results for the destination zones were used. These results will be discussed in a later chapter.

A Check on the Reliability of the Origin-Destination Information

Checking the reliability of the origin-destination data is very difficult in a study such as this. The only method of checking the data is a comparison and inspection of all data on employment, population and mode split to determine whether or not the figures obtained are reasonable. This method is not an accurate check on the data but can be used to correct or disregard zones in which large discrepancies do occur.

The first comparison made was that of the employment in the Central Business District as obtained from the origin-destination surveys with that obtained by the Planning Department in 1961. TABLE 4-VII shows the total employment figures by the various studies with the 1964 figures being broken down into those under twenty one years old and those over twenty one years old. The total employment figures differ slightly from those used in the discussion on employment changes since the figures used

in this table include all employees in the Central Business District, whereas those used in the previous chapter deal only with the employees originating from the zones being considered in this study.

TABLE 4-VII

EMPLOYMENT IN THE CENTRAL BUSINESS DISTRICT

Zone	1961		1964 O-D		Total
	Planning	O-D	Over 21	Under 21	
0010	12,284	8,340	8,952	619	9,571
0020	12,437	9,640	8,370	632	9,002
0030	1,950	1,200	1,629	94	1,723
0040	4,489	3,200	3,109	231	3,340
0050	997	640	548	49	597
0060	4,281	4,090	4,577	412	4,989
0070	247	410	295	6	301
Total	36,685	27,520	27,480	2,043	29,523

The Planning Department figures of employment in 1961 are considerably higher than the origin-destination figures of both 1961 and 1964. The most obvious reason for the discrepancy in the figures is that the employment figures obtained by the Planning Department were obtained by interviewing downtown employers during the summer months whereas the origin-destination figures were obtained by interviewing employees during April and May. This leads to the possibility that employers reported employee figures which included summer replacement as well as the people away on holidays. Additional employees which many firms hire during the summer would also have been included in the planning department survey. Another source of error which could arise when interviewing employers

rather than employees is that employers may report employees who are paid from a downtown office but do not actually work downtown. Included in this category would be salesmen who only report at a downtown office occasionally or employees who work in a small branch office and are considered as employees at the downtown office. It would seem that the origin-destination figures are more reasonable for the study being done at present, however the figures in TABLE 4-VII illustrate the differences that do occur when conducting different types of surveys and when considering different periods during the year.

The only employment figure obtained from the origin-destination surveys which is considered unreliable is that for zone 0070 in 1961. This figure is considerably above that of the Planning Department and that of 1964. However, this discrepancy will not be investigated since the number involved is relatively small in regards to total employment and zone 0070 is not being used in the establishment of modal split relationships.

In 1964 7.4 percent of the total downtown employment was made up of people under the age of twenty one. Although the percentage of these employees that use transit is probably greater than that for employees over twenty one because of no available car, neglecting these employees in 1961 will not significantly affect the mode split results.

Another method of checking the reliability of the origin-destination results is to compare population and employment figures for each year. An extremely high or low percentage of employment would cast

doubt of the reliability of the origin-destination data for that zone if no explanation for the discrepancy could be obtained. TABLE 3-I which was used in the discussion on population and employment changes can also be used to determine the reliability of the origin-destination data.

In 1961 zones 2360, 2440, 2450 and 3010 showed extremely low percentages of employment with the discrepancy in zones 2360 and 3010 probably being due to the small sample size. The fact that no population or employment was recorded for zone 2450 was most definitely an oversight in the sample selection. In zone 2440 the reason for the discrepancy cannot be determined although it is probably due to an error in sampling or an error in recording.

The 1964 discrepancies are most likely all recording errors as the sample size was large enough to eliminate errors occurring from incorrect sampling. The zones on which doubt is cast as to reliability of the results are 820, 1040, 1110 and 1550 with the first three having extremely low percentage employment and zone 1550 having an employment of 278 while the population is only recorded as 213.

The discrepancies in the above mentioned zones must be considered in carrying out the modal split analysis as well as in calculations of population and employment changes as was done in the previous chapter.

CHAPTER V

THE ECONOMIC STATUS OF THE ORIGIN ZONES

A trip maker's economic status is one of the most important factors in his choice of mode. People in the higher income brackets generally make more trips than those in lower brackets but they normally seem adverse to riding public transit. Thus people of higher income usually are more susceptible to changes in travel time ratio or level of service with the result that modal split diversion curves for these people are generally steeper than those for low income people. The percentage of captive transit patrons, those having no access to a car, is higher among the lower income groups resulting in a higher and flatter diversion curve for this group.

Methods of Measuring Economic Status

Two of the most common measures of economic status are average income and car ownership. Average income can either be expressed as average income per worker or as average income per family. Average income per family gives a better idea of what a family can afford since the income of the second or third worker in a family normally places that family in better financial position than those with only one worker. However, for the purpose of transportation studies unless a family can afford two cars, one worker will be a captive transit patron thereby in-

creasing the mode split in the area. Average worker income may therefore be a better measure of economic status for the purpose of transportation studies. In making comparative studies incomes must be adjusted to a common base to allow for increasing standards of living and the general increases in wages.

Car ownership which is normally expressed as the number of cars per dwelling, is becoming more widely used as a measure of economic status. The availability of a car means that it will probably be used and with trend of car ownership continuously increasing this is probably a very reliable measure of economic status for the purpose of transportation studies. Car ownership figures would not require adjusting as is necessary when using income as a measure of economic status.

In the present study, the lack of accurate income figures and the lack of reliable car ownership data necessitated using another measure of economic status. The measure adopted was the average house sale value because of the ease with which it could be obtained and the small variation in house value between 1961 and 1964. House value is a fairly accurate measure of the relative status of zones within an urban area and in all probability people that live in expensive housing areas, though they may be in a lower income bracket than the average of the area, will not ride transit. On the other hand people with lower incomes would live in less expensive housing areas and would in all probability ride transit because of the lower cost of transportation.

Calculation of Average House Sale Value

The City of Edmonton Land Department maintains a record of all house sales in the city during the year. At the end of each year the number of sales and the average price for each of 135 residential districts is recorded on a map and turned over to the Alberta Bureau of Statistics. The house value determinations for this study were made from the maps of 1961 and 1964 which were obtained from the Alberta Bureau of Statistics.

Since there was very little difference between the 1961 and the 1964 house sale values, the 1961 and 1964 values for each district were averaged using a weighted average based on the number of sales in each year. The average house sale value for each traffic zone was then determined by arithmetically averaging the values of all districts or partial districts lying within the boundaries of the traffic zone. If the district sizes and house values within a zone varied considerably, a weighted average based approximately on the areas in each district was used to determine the value for the zone.

No information was available on the house sale value of Jasper Place zones 1010, 1120, 1140 and 1150 so estimates of the value in these zones had to be made. These estimates were made by a visual inspection of the zones and a comparison to adjacent zones for which house values were available. Zone 1010 was found to be similar to 1020, 1120 and 1140 were equivalent to zones 1110 and 1130, and zone 1150 was taken as an average of zones 1160 and 1170.

TABLE 5-I outlines the average house sale values for each traffic zone as obtained by the above method.

Comparison of House Sale Values to the 1961 Dominion Census Data

In order to compare the house values as used in this study to the house values and incomes reported in the 1961 census it was necessary to calculate the average house sale value for each census tract. This was done in the same manner as for the traffic zones except that more districts had to be averaged into each of the 45 census tracts. As Jasper Place was not part of Edmonton in 1961 it was not subdivided for the Dominion Census. Therefore it will not be included in the comparisons with the house sale value.

House Value

FIGURE 5-1 illustrates the correlation obtained between the average house sale value as used in this study and the house value as reported to the census. The curve was obtained by calculating, using the Least Squares Method, the best fit curves in both directions with the curve drawn as the average between the two. Only house values up to \$22,000 were included in the curve as the census value for zones above \$25,000 house sale value is considerably below that obtained from the average of sale prices.

It can be seen on this curve that the value of houses as reported to the census is approximately \$1,000 higher than the actual sale price. As house value increases, the difference between the reported value and the actual sale price decreases which could be a result

TABLE 5-I

AVERAGE HOUSE SALE VALUES

ORIGIN ZONE	HOUSE VALUE	ORIGIN ZONE	HOUSE VALUE	ORIGIN ZONE	HOUSE VALUE
110	12591	910	28228	2010	12669
120	11594	920	18299	2020	15550
140	9631	930	17455	2110	11843
150	8306	940	35196	2120	9514
210	13534	960	-----	2130	11167
220	14204	1010	12616	2140	10865
230	12792	1020	12616	2220	25160
240	14505	1030	13998	2230	21388
250	14504	1040	18811	2250	33183
260	10218	1110	8239	2310	12750
310	17945	1120	8239	2320	12669
320	17945	1130	8239	2330	13107
330	17945	1140	8239	2340	13098
340	18550	1150	11077	2350	13304
410	9629	1160	10262	2360	15010
430	10840	1170	11892	2370	14663
440	15876	1310	12909	2410	10796
510	9433	1320	13081	2420	10919
520	9382	1330	12367	2430	12172
540	14776	1340	13722	2440	15233
550	9551	1410	14857	2450	13362
560	9985	1420	14857	2460	13729
710	9752	1430	13575	2470	11869
720	12347	1440	11499	2510	13650
730	11897	1520	9720	2520	15398
810	13985	1540	12847	2530	13731
820	13427	1550	11499	2540	13335
830	15508	1620	11091	2610	13618
840	15508	1630	11482	2620	16753
860	12526			2630	14636
870	14762			2640	15545
880	12708			2710	17476
				2720	16257
				3010	17518

Note: House values are in dollars

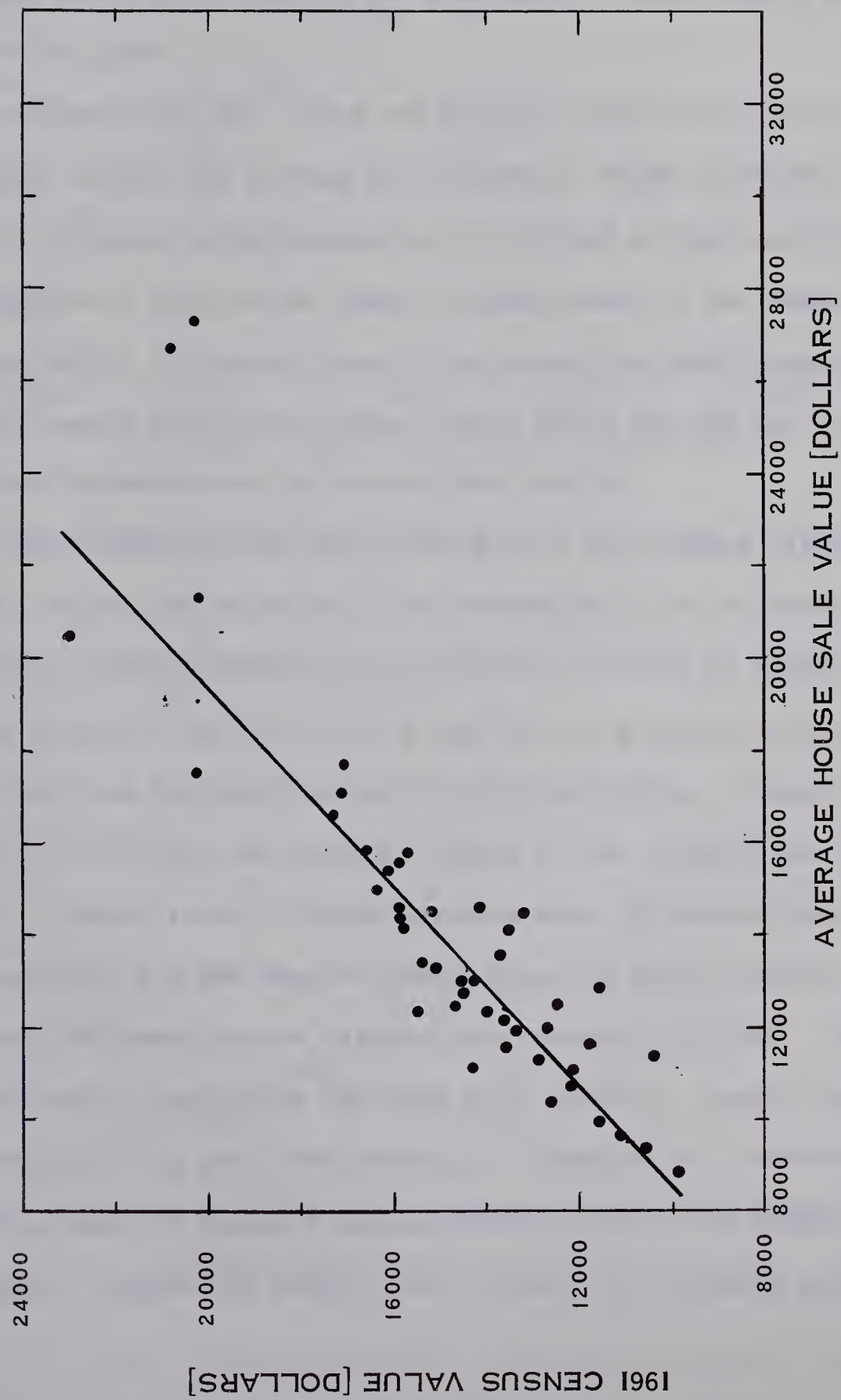


FIGURE: 5.1 COMPARISON OF HOUSE SALE VALUE TO CENSUS VALUE

of people in more expensive areas being more aware of actual housing values as well as the fact that the more expensive areas in most cases are the newer areas which enables the home owner to more easily estimate the value of his home.

Average house sale value was plotted against total family income, average worker income and average male income as shown on FIGURES 5-2, 5-3 and 5-4. Average worker income was calculated as the weighted average of the average male and average female incomes based on the number of employees of each. All curves were fitted using the Least Squares Method omitting the census tracts with house values above \$25,000 and the three extremely low census tracts which have been circled.

Upon inspecting the three tracts with low incomes relative to the house value, the house value was determined to be in error in census tracts 15 and 19 whereas the income was in error in census tract 45. Census tracts 15 and 19 are very near the city center where house sale value has been inflated because of high land prices. These values therefore do not reflect the economic status of the resident and should be adjusted. Census tract 15 which contains zone 110 should have a house value of less than \$10,000 whereas census tract 19 which includes zones 310, 320 and 330 should have a value of approximately \$12,000. These changes were made in analyzing the mode split results. Census tract 45 is an outlying area which was starting to develop as a residential area in 1961, thus the income figures probably reflect the income of the rural resident whereas the house value reflects the economic status

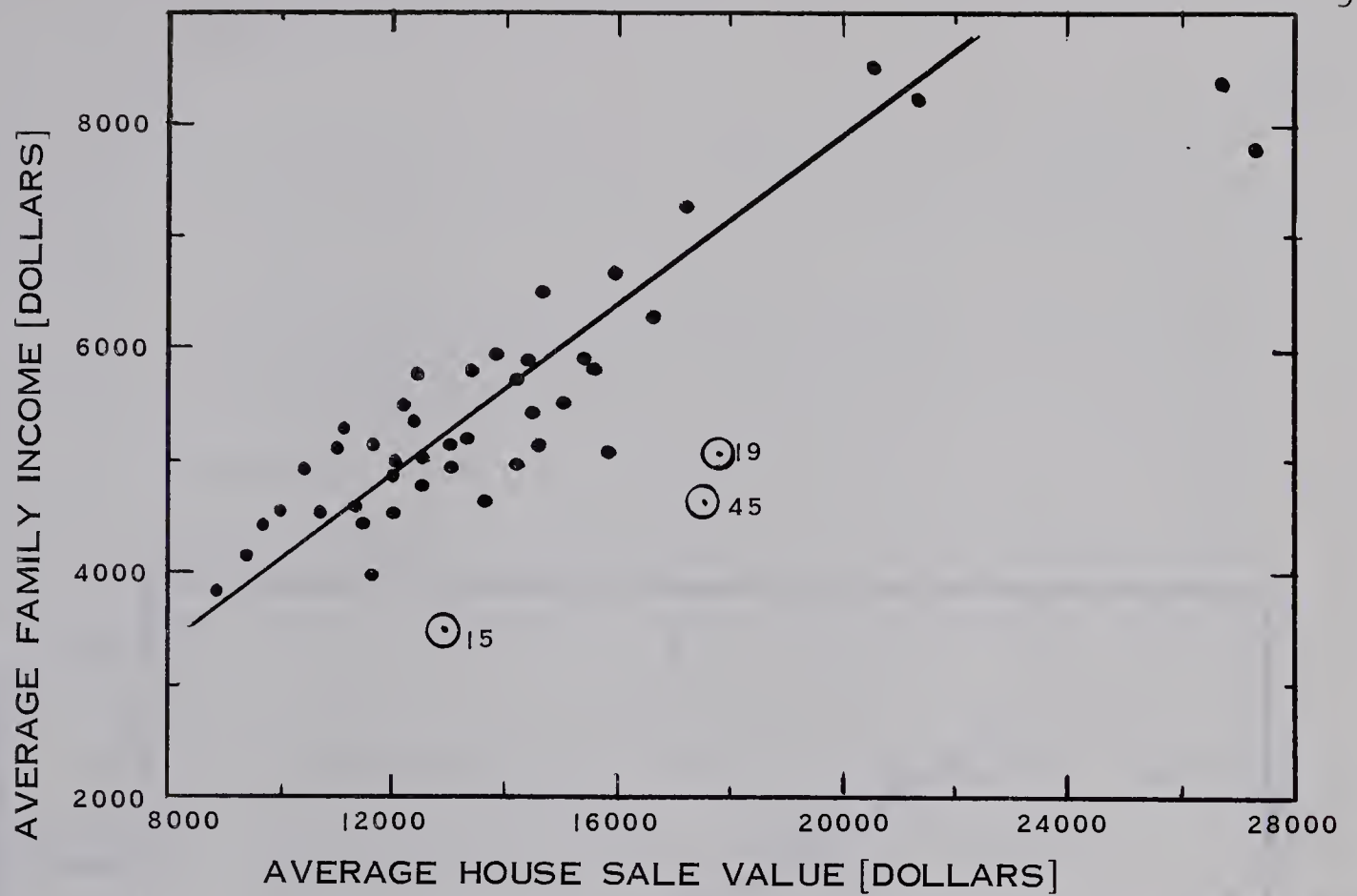


FIGURE 5.2 CORRELATION OF HOUSE VALUE TO FAMILY INCOME

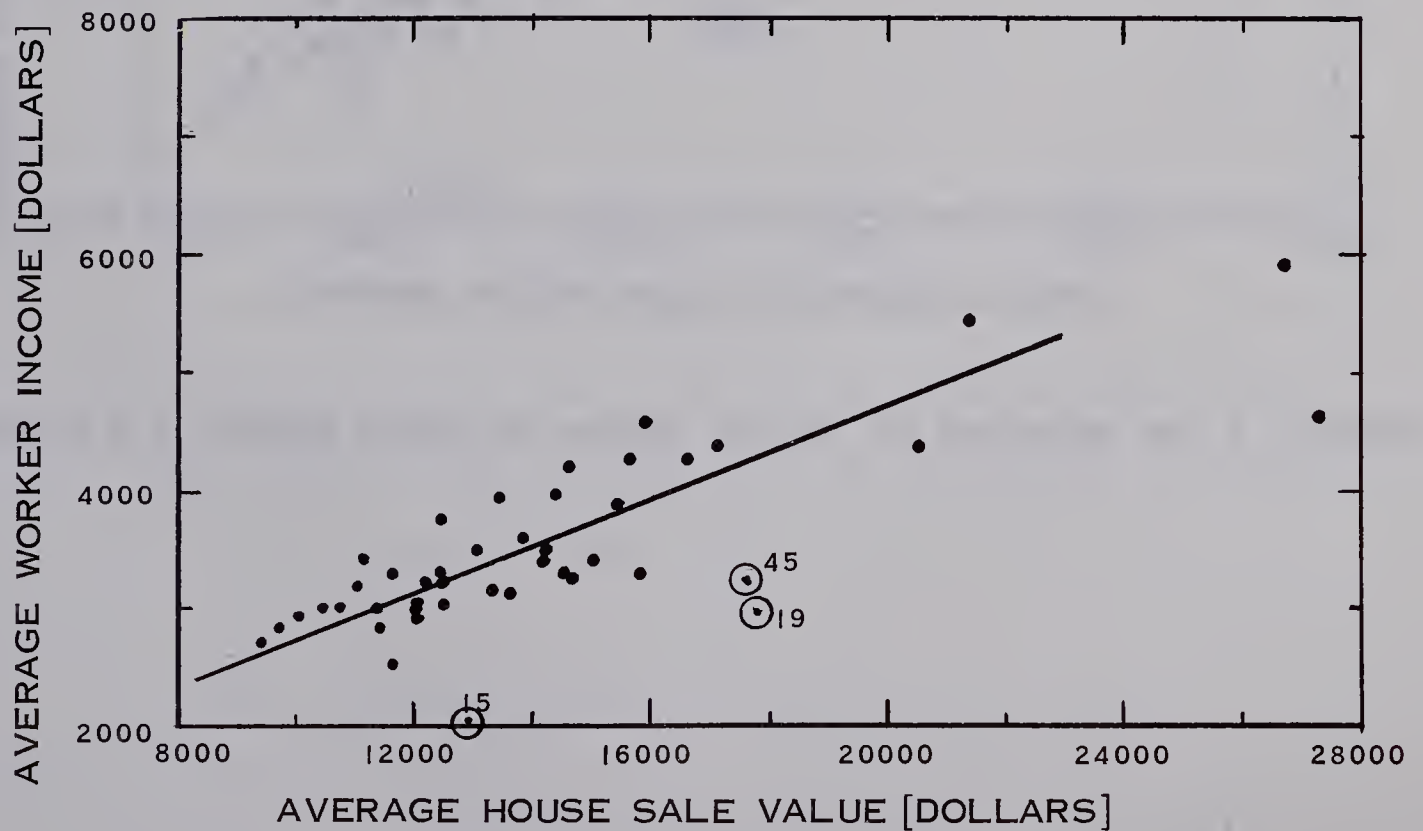


FIGURE 5.3 CORRELATION OF HOUSE VALUE TO WORKER INCOME

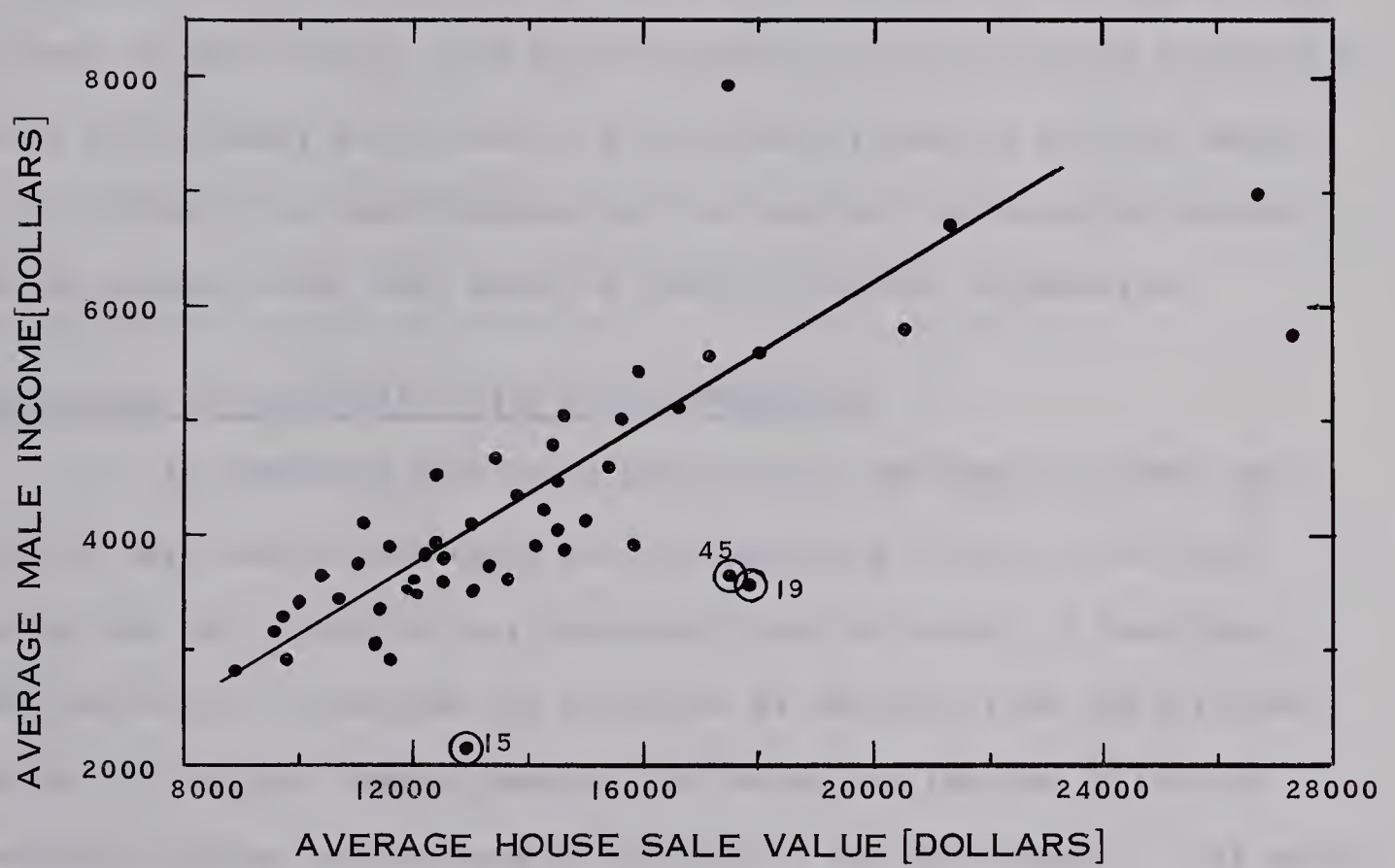


FIGURE: 5.4 CORRELATION OF HOUSE VALUE TO AVERAGE MALE INCOME

of the people moving into the newly built homes so the house sale value will be used as is.

In comparing the income relationships with the ranges used in the study by Traffic Research Corporation (Traffic Research Corporation, 1963) the average worker income curve is far below the ranges of \$4,500 to \$5,900, \$5,900 to \$7,100 and \$7,100 and over used for average worker incomes in their study. The figures used by Traffic Research Corporation agree more closely with those of average male income or average family income. These two relationships will be used in comparing the results of the present study with those of Traffic Research Corporation.

Comparison of House Sale Value to Car Ownership

In comparing house sale value to car ownership in 1961, two methods were used in obtaining the car ownership figures. The first method was calculation of car ownership from the number of dwellings and the number of vehicles for each zone as obtained from the printout of the 10 percent sample, whereas the second was the use of the car ownership figures as outlined by district in the METS report. This method necessitated calculation of house sale values by traffic district which was done in the same manner as for traffic zones by averaging the values of the districts falling within each traffic district. The correlations obtained are shown on FIGURE 5-5 and FIGURE 5-6.

The open triangles on the two curves were obtained by averaging the points in \$2,000 increments of house value. There is a great deal of scatter of the points on the plots. However, the two

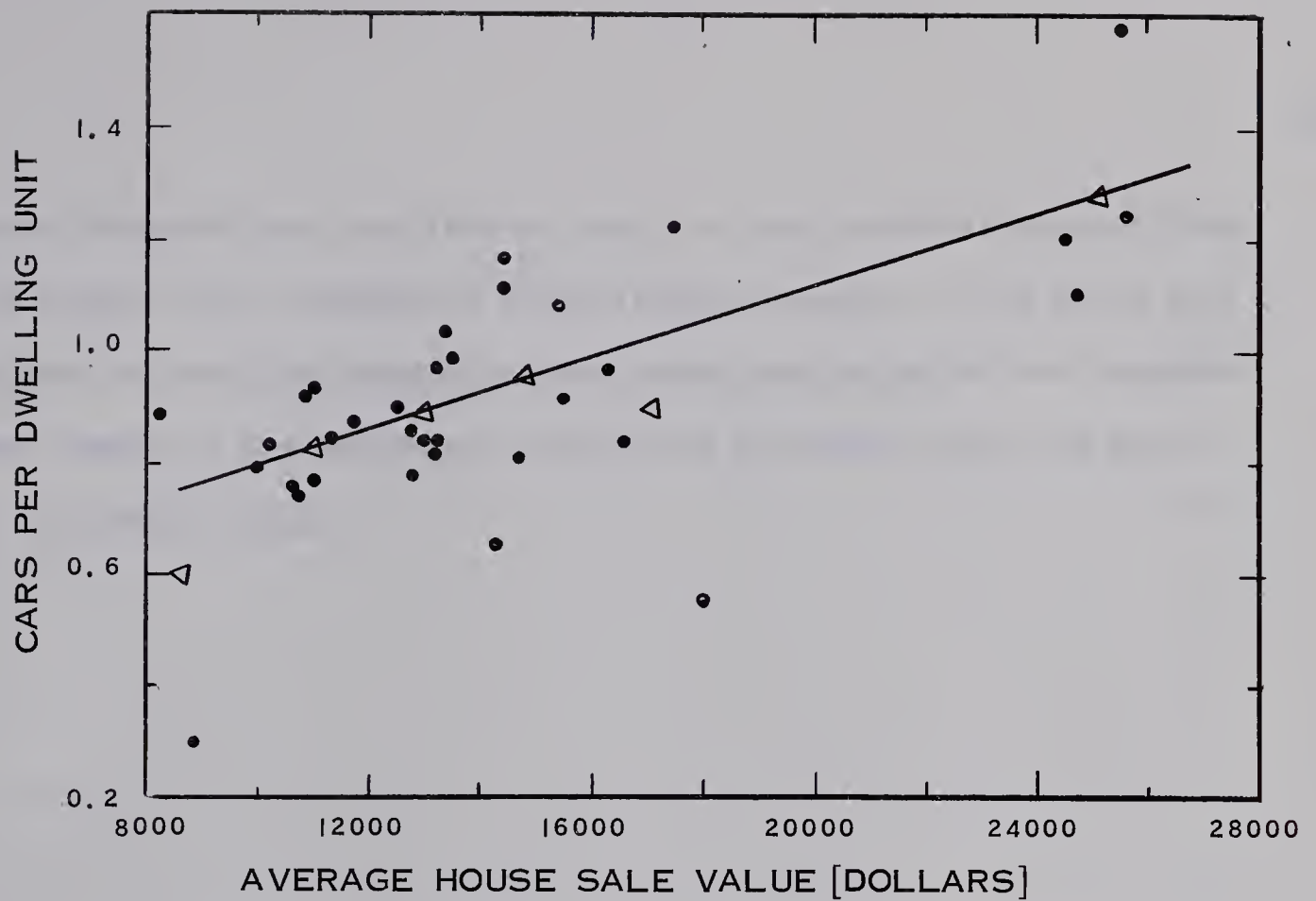


FIGURE 5.5 CORRELATION BETWEEN HOUSE VALUE AND
CAR OWNERSHIP BY TRAFFIC DISTRICT

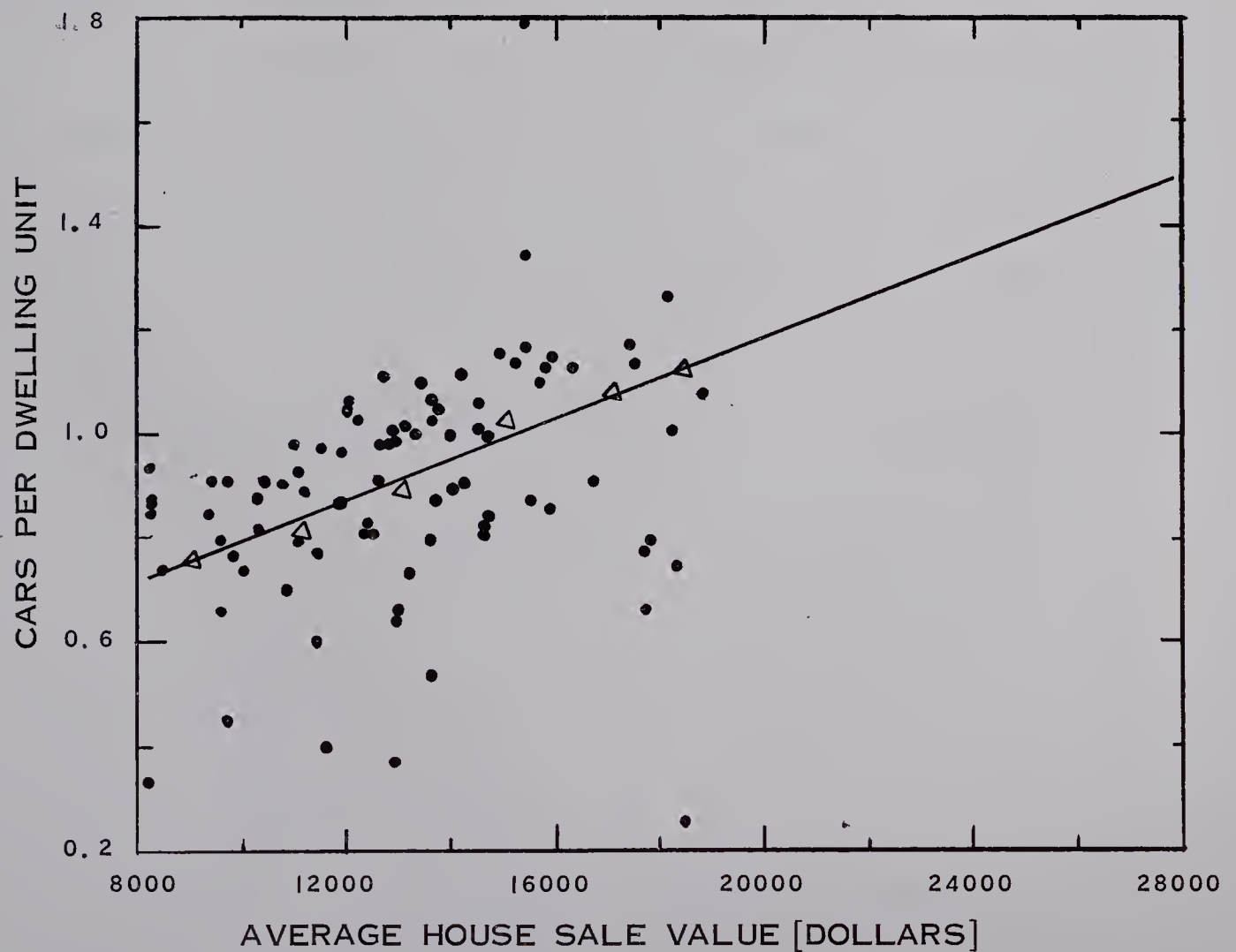


FIGURE 5.6 CORRELATION BETWEEN HOUSE VALUE AND
CAR OWNERSHIP BY TRAFFIC ZONE

curves obtained are very similar with the curve which is plotted from the traffic zone information being slightly steeper. This curve will be used as the relationship between house sale value and car ownership when comparing the modal split results of the METS report and those of the present study.

CHAPTER VI

TRAVEL TIMES AND PARKING AVAILABILITY

The second and most difficult variable to calculate in determining mode of travel is the relative travel time between transit and car. Door-to-door travel time must be considered in determining travel time so estimations are required for excess travel time. With excess travel time for some transit trips amounting to 50 percent of the total travel time errors in estimating excess travel time could have a significant effect on the relative travel times.

Establishing the Zone Centroids

The centroid of a zone is considered as the point in a zone from which all trips originate or to which all trips are destined. Zone centroids should be located at the center of activity of the zone (U.S. Department of Commerce, 1964) which, for residential zones, would be the center of gravity of the population as shown on FIGURE 6-1. In this figure each dot represents 100 persons with the centroid being located by the X .

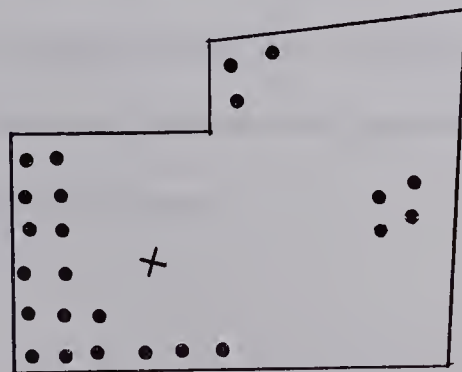


FIGURE: 6.1 CALCULATION OF ZONE CENTROID

[FROM U. S. DEPARTMENT OF COMMERCE, 1964]

For zones of mixed land use the centroid is selected largely by judgement and by inspection of the zone.

In Edmonton the zone centroids were established during the METS study and the centroids for all but the combined downtown zones were accepted for the present study. Since zones 0010 and 0020 and 0030 and 0040 were combined new centroids had to be established for the combined zones.

Jasper Avenue and 101 Street was chosen as the centroid for zone 0010 and 0020 as this is one of the major intersections in the zone. Since 101 Street and Jasper is the focal point of most of the transit routes it is considered to be the center of activity for this zone.

In zone 0030 + 0040 Jasper Avenue and 107 Street was selected as the centroid because it is on the major east-west bus routes. However, since the actual center of activity is probably slightly north of this intersection, one minute was added to the walking time of transit patrons. It was felt that no adjustment was required for car travel time because of the flexibility of the car.

The centroid of zone 0060 was accepted as 97 Avenue and 107 Street which was established for the METS, since this intersection is on the main artery through the government center as well as on the bus route serving the area.

Running Time By Car

Car running time is the time actually spent in driving from the origin to the destination. It does not include time spent looking for a parking space or the time spent parking and unparking the car.

Running time is calculated by making timed runs with a car on all major routes of the traffic network. The number of runs made on each route depends on the variability of the time on each run with about three runs of fairly equal time being considered sufficient. Errors may arise where on one run out of four a lengthy delay was incurred due to traffic congestion at some point. This run would normally be disregarded whereas it may in fact be that on about one day per week traffic congestion does occur at this point. If traffic congestion does occur frequently on a particular route, drivers would tend to allow extra time for their home to work journey thus making the time on the longest run the more accurate time.

In dealing with the home to work journey care must be taken in order to obtain the travel time during the peak traffic period. Since the peak period, and thus the longest travel time, takes place over a period of about fifteen minutes it is important that the travel time measurements be made during this time.

The only available data on car travel times in Edmonton was a map obtained from the consultants for the METS showing the distance and peak period travel speed for each link on the major arteries in 1961. Using the speeds and distances, the peak travel times were calcu-

lated for each link and a travel time "tree" was established for each of the downtown destination zones showing the cumulative travel time from downtown to each junction in the traffic system. From the travel time "trees" the travel time from the centroid of each origin zone to each of the three destination zones was recorded as shown on TABLE 6-I. It will be noted that the travel times shown on TABLE 6-I include four minutes of excess time.

Since no car travel times were available for 1964 it was assumed that travel time by car did not change between 1961 and 1964. This assumption was based on the fact that there were no major changes to the street network and no change in downtown employment during the three year period. A comparison of the 1961 travel times to the preliminary results of a 1966 travel time survey resulted in little difference in travel times. Thus the car travel times as shown on TABLE 6-I will be used for both 1961 and 1964 calculations.

Excess Travel Time by Car

Excess travel time by car includes the time for unparking at the origin end, looking for a parking space and parking at the destination end, and walking from the parking location to the final destination. Since most workers park in the same location every day, the time spent looking for a parking space would be negligible. In this study, as in the one done by Traffic Research Corporation, no time was allowed for unparking the car at the origin end of the trip.

At the destination end of the trip four minutes was allowed

TABLE 6-I

CAR TRAVEL TIMES

(Includes 4 min Parking + Walking Time)

Origin Zone	Destination Zones			Origin Zone	Destination Zones		
	0010 0020	0030 0040	0060		0010 0020	0030 0040	0060
110	11.1	10.7	12.1	1310	22.9	20.6	22.3
120	12.1	11.7	13.1	1320	22.7	20.3	22.0
140	11.0	13.5	14.3	1330	21.5	20.8	22.1
150	11.2	14.2	11.9	1340	20.2	19.4	20.8
210	9.7	7.7	10.1	1410	19.6	18.9	20.2
220	13.7	12.2	13.7	1420	20.7	20.1	21.5
230	12.3	9.3	11.0	1430	22.2	21.6	23.0
240	14.4	11.3	12.1	1440	23.1	22.5	23.9
250	16.0	13.1	14.0	1520	19.3	19.8	21.0
260	16.3	15.7	17.3	1540	22.0	22.5	23.7
310	10.2	8.5	8.0	1550	24.4	23.8	25.2
320	10.8	9.0	8.6	1620	23.4	24.1	25.1
330	12.1	10.3	9.9	1630	21.4	23.2	24.0
340	14.9	13.1	12.7	2010	11.4	12.6	10.4
410	15.3	15.8	17.0	2020	11.4	12.4	9.7
430	16.7	17.2	18.4	2110	10.5	14.1	11.5
440	18.7	19.2	20.3	2120	8.9	12.5	10.5
510	14.6	14.3	15.7	2130	10.7	14.3	12.3
520	15.1	14.5	15.9	2140	11.2	14.8	12.8
				2220	13.7	13.6	12.0
540	18.6	18.6	19.3	2230	14.7	15.7	13.4
550	18.8	18.2	19.5	2250	18.4	19.4	17.1
560	16.9	16.1	17.4	2310	13.4	14.5	12.1
710	18.4	16.1	17.8	2320	13.2	14.5	12.3
720	18.2	15.4	16.2	2330	15.3	16.4	14.0
730	15.1	12.3	12.9	2340	15.0	16.1	13.7
810	18.6	17.8	17.6	2350	14.1	15.3	13.1
820	19.0	18.3	18.1	2360	15.6	17.4	15.4
830	17.7	17.6	16.8	2370	16.8	17.8	15.8
840	17.1	17.0	16.2	2410	13.5	16.5	14.3
860	15.9	15.8	14.9	2420	12.1	15.7	13.7
870	17.4	17.4	15.4	2430	13.9	17.5	15.5
880	17.4	17.4	15.4	2440	15.0	18.5	16.6
910	17.9	16.1	15.7	2450	16.4	19.5	17.1
920	19.3	17.5	17.1	2460	15.4	18.4	16.4
930	20.5	19.7	19.3	2470	14.3	17.5	15.3
940	20.8	20.0	19.5	2510	10.5	14.1	12.1
960	26.1	25.3	24.9	2520	11.1	14.7	12.8
1010	23.5	22.7	22.2	2530	11.5	15.1	13.2
1020	21.6	20.8	20.4	2540	13.1	16.7	14.7
1030	24.5	23.7	23.3	2610	12.7	16.3	14.3
1040	23.5	22.7	22.3	2620	14.8	18.4	15.6
1110	21.5	19.3	18.9	2630	18.7	21.4	19.4
1120	24.0	21.8	21.3	2640	15.9	19.6	17.6
1130	20.7	18.9	18.5	2710	13.7	17.3	15.3
1140	22.4	20.9	20.6	2720	13.3	16.9	14.9
1150	21.3	21.3	19.3	3010	17.1	18.2	15.8
1160	18.7	18.8	16.8				
1170	20.4	21.2	19.4				

Note: Travel times are given in minutes

as the time required to park the car and walk to the final destination. This figure agrees with the four minutes used by Traffic Research Corporation and compares quite closely with the four to five minutes which was used in the Winnipeg Area Transportation Study. The four minute parking and walking time is also substantiated by the results of a study on a downtown office building conducted by the City of Edmonton in 1965. It was found in this study that the average walking distance for the 124 auto drivers in the building was 1.4 blocks. Assuming a walking speed of two minutes per block results in a walking time of 2.8 minutes and a parking time of 1.2 minutes which should be sufficient. The parking survey done for the METS (Stanley, Grimbale, Roblin and Barton Aschman Assoc., 1962) revealed an average walking distance of 1.1 blocks which would require a walking time of 2.2 minutes leaving 1.8 minutes for parking the car.

Transit Running Time

Transit running time can be calculated with greater accuracy than car running time as transit vehicles run on a fixed route with a fixed schedule. However, overall transit travel time cannot be calculated with any greater accuracy since the number of variables in the excess travel time is greater than for car time.

Running times for transit in Edmonton were calculated for both 1961 and 1964 since many transit route changes were made during this period. However, the travel times from the Jasper Place zones were assumed to be the same for both years as Diamond Bus Lines provided the

bus service to this area at the time of both studies.

The 1961 running times for transit were obtained from riding time checks made on each transit route by the Edmonton Transit System. Times were checked during the morning peak, the evening peak and midday and the average running time on each link for each time period was recorded on a transit route map. In comparing the measured travel times with the schedule times in 1961 very little difference was observed between the morning peak running time and the scheduled time on most routes.

Running times were not available for 1964 so schedule times were used as the morning peak travel time. Since schedule times are given for quite widely separated points it was necessary to assume the travel times on shorter links so that times could be computed to each of the origin zones.

Riding time checks were made during August of 1966 on some of the routes on which schedules had not changed since 1964. As shown in Appendix A the riding time checks on these routes agree quite closely with the schedule times. The significance of these riding checks could be questioned as only one run was made on each route but they do indicate that the drivers normally are able to maintain schedule times during the morning peak.

Having obtained the link travel times for both 1961 and 1964, travel time "trees" were established to the three Central Business District destination zones for each year. From these "trees" the travel

time to each of the destination zones was calculated.

The zones in Jasper Place were not served by the ETS in either 1961 or 1964 so were not included on the travel time trees. Travel time for these zones was obtained from a table prepared for the METS by Barton-Aschman Associates Inc. in 1961.

Excess Travel Time by Transit

The number of variables involved in the calculation of excess travel time by transit makes this time more susceptible to error. Times must be estimated for walking to and from the bus, waiting for the bus and transferring from one bus to another.

Waiting time was calculated as one-half the frequency of service up to a maximum of 5 minutes. This method of calculation is fairly standard where no survey is available (Sossiau and Balek, 1965).

Transfer times were calculated as one half the frequency of service for routes of less than 10 minute frequency and as the difference in schedule times for all other routes.

In the calculation of walking times to and from transit, the results of the ETS rider survey were used in obtaining the walking distances as discussed in CHAPTER IV. Since walking speed for pedestrians going to and from bus stops was unknown a survey of walking speeds was conducted on pedestrians walking past Churchill Square in front of the Edmonton City Hall. The fact that these sidewalks border the open square meant that pedestrians could not window shop and would therefore walk at a speed more comparable to that of people going to and from work. Observa-

tions were not made on elderly people or on people with small children. A total of 36 readings were taken on females and 42 readings on males with the average walking speeds being 3.19 miles per hour and 3.46 miles per hour respectively. The resulting average walking speed would be 3.33 miles per hour or 1.7 minutes per five hundred foot block which was assumed as the average block length. The 1.7 minutes per block was used in determining the average walking time in all origin zones but it was increased to 2.0 minutes per block in the Central Business District to allow extra time for crossing signalized intersections.

Having calculated the various components of transit travel time, the total time was computed for both 1961 and 1964 with the results for the three destination zones tabulated in Appendix B. As an illustration of the effect of the transit changes, the travel times to zone 0010 + 0020 for both 1961 and 1964 are shown in TABLE 6-II. Zones having a decrease in travel time of more than six minutes are marked with an asterisk. These zones are for the most part those to which express service was extended in 1964 resulting in decreases in travel time of up to twelve minutes or about 25 percent. The effect of these large time decreases on the mode split was investigated and will be considered later.

Parking Availability

Since parking most definitely has an effect on choice of mode, an analysis of the number of employee parking stalls in the Central Business District was conducted. Parking surveys were carried out in downtown Edmonton in 1961, 1963 and 1965 with the number of parking stalls in each

TABLE 6-II

TRANSIT TRAVEL TIMES TO ZONE 0010 + 0020 (in minutes)

Origin Zone	Transit Travel Time			Origin Zone	Transit Travel Time		
	1961	1964	Change ¹		1961	1964	Change ¹
110	14.7	14.8	- 0.1	1310	46.8	39.8	7.0*
120	17.3	16.7	0.6	1320	50.3	38.3	12.0*
140	17.2	15.4	1.8	1330	44.6	34.1	10.5*
150	19.1	18.1	1.0	1340	42.3	33.8	8.5*
210	17.4	15.6	1.8	1410	41.8	34.3	7.5*
220	22.6	20.1	2.5	1420	44.8	39.3	5.5
230	25.2	23.2	2.0	1430	52.1	42.5	9.6*
240	25.5	23.8	1.7	1440	46.2	37.7	8.5*
250	31.7	24.7	7.0*	1520	42.0	36.5	5.5
260	30.7	25.7	5.0	1540	36.6	32.1	4.5
310	14.0	13.6	0.4	1550	51.5	42.0	9.5*
320	16.0	14.9	1.1	1620	33.7	37.0	- 3.3
330	18.6	16.9	1.7	1630	27.2	28.0	- 0.8
340	20.8	20.8	0	2010	29.2	25.2	4.0
410	23.9	22.7	1.2	2020	18.1	18.1	0
430	24.6	23.8	0.8	2110	21.1	17.9	3.2
440	30.8	29.3	1.5	2120	19.7	19.7	0
510	21.6	21.9	- 0.3	2130	21.4	25.4	- 4.0
520	26.6	26.6	0	2140	23.5	27.5	- 4.0
540	38.3	30.3	8.0	2220	38.9	32.9	6.0
550	38.0	36.0	2.0	2230	31.4	31.9	- 0.5
560	32.6	31.9	0.7	2250	--	38.8	--
710	40.9	30.9	10.0*	2310	27.8	24.8	3.0
720	30.7	30.2	0.5	2320	31.3	32.3	- 1.0
730	25.8	24.5	1.3	2330	31.9	30.4	1.5
810	40.4	33.4	7.0*	2340	29.3	32.8	- 3.5
820	43.2	37.2	6.0	2350	40.1	39.1	1.0
830	41.3	37.8	3.5	2360	--	40.0	--
840	37.5	31.0	6.5*	2370	42.0	34.0	8.0*
860	38.1	28.1	10.0*	2410	28.3	23.7	4.6
870	36.4	32.4	4.0	2420	25.9	28.9	- 3.0
880	35.6	31.6	4.0	2430	28.5	31.5	- 3.0
910	27.8	29.3	- 1.5	2440	31.2	33.2	- 2.0
920	32.3	32.8	- 0.5	2450	43.3	39.3	4.0
930	39.0	39.0	0	2460	38.2	32.6	5.6
940	41.8	42.3	- 0.5	2470	36.2	30.7	5.5
960	--	--	--	2510	20.6	22.6	- 2.0
1010	50.1	50.1	0	2520	23.9	26.9	- 3.0
1020	44.1	44.1	0	2530	23.0	26.0	- 3.0
1030	48.2	48.2	0	2540	27.4	32.9	- 5.5
1040	48.2	48.2	0	2610	27.6	27.1	0.5
1110	39.8	39.8	0	2620	26.6	24.4	2.2
1120	51.3	51.3	0	2630	32.4	32.6	- 0.2
1130	34.3	34.3	0	2640	35.4	33.4	2.0
1140	57.0	57.0	0	2710	34.8	31.8	3.0
1150	53.1	53.1	0	2720	38.8	34.8	4.0
1160	39.6	39.6	0	3010	--	38.0	--
1170	44.4	44.4	0				

¹1961 Travel time minus 1964 travel time

*Indicates a decrease in travel time of greater than 6 minutes

block being reported as shown on FIGURE 6-2 . Using these surveys the total number of parking stalls were calculated for each zone in the Central Business District with the results shown in TABLE 6-III. The number of parking stalls in zone 0060 does not include the parking available on the west side of the CPR tracks since the parking surveys did not include this area.

In determining the number of parking stalls available to employees, the results of a postcard passout survey conducted in 1961 (Stanley, Grimble, Roblin, Ltd. and Barton Aschmann Assoc., 1962) were used. The postcards were placed on all cars parked in zones 0010, 0020, 0030 and 0040 during the peak parking accumulation period of 2:00 to 3:00 p.m. asking the reason for parking, the final destination of the parker and the length of time parked. Thirty-six percent of the cards were returned and the usage of parking stalls by employees was as follows:

Metered curb stalls	19%
Free curb	81%
Random and Offstreet lots	69%
Private and employee lots	92%
Total	65.5%

The number of employee stalls in each zone was calculated by applying the above percentages to the total number of stalls and the 1964 figures were determined by averaging those of 1963 and 1965.

METROPOLITAN EDMONTON TRANSPORTATION

PARKING INVENTORY SURVEY

Recorded by				Sterk, J.		CURB		Date		July 5th., 1965		OFFSTREET	
Block No.	Metered Curb	Free Curb	Total Curb	Meters	Random	Customer Lots	Comm. Lots	Private Lots (emp.)	Total Off-Street	Total Parking			
1	0	72	72	--	10	---	-	1	11	83			
2	0	74	74	--	5	4	0	5	14	88			
3	0	37	37	--	2	---	0	15	17	54			
4	0	63	63	--	2	---	-	34	36	99			
5	0	11	11	--	--	---	-	12	12	12			
6	0	15	15	--	--	101	-	14	115	130			
7	0	22	22	--	--	---	-	---	---	22			
8	0	13	13	--	1	---	-	8	9	22			
9	0	24	24	--	12	---	-	---	12	36			
10	0	55	55	--	7	---	-	215	222	277			
11	0	31	31	--	1	8	-	12	21	52			
12	0	43	43	--	2	4	-	24	30	73			
13	11	54	65	--	2	38	-	6	46	111			
14	0	77	77	--	3	8	-	8	19	96			
15	9	42	51	--	8	---	-	13	21	72			
16	0	60	60	--	8	---	-	---	8	68			
17	0	74	74	--	21	---	-	---	21	95			
18	0	27	27	--	3	---	-	14	17	44			
19	6	57	63	--	6	41	-	13	60	123			
20	31	2	33	--	5	172	-	20	197	230			
21	34	44	78	--	3	26	-	5	34	112			
22	40	26	66	--	7	140	-	42	189	255			
23	46	19	65	71	--	62	-	30	163	228			
24	50	8	58	--	3	---	-	43	46	104			
25	0	19	19	--	2	---	-	---	2	21			
26	0	38	38	--	--	---	-	9	9	47			

FIGURE 6.2 DATA SHEET FOR PARKING INVENTORY

TABLE 6-III

PARKING STALL AVAILABILITY IN THE CENTRAL BUSINESS DISTRICT

Dest Zone	Metered Curb	Free Curb	Total Curb	Metered Lots	Random	Customer Lots	Commercial Lots	Private Emp. Lots	Total Offstreet	Total Parking
1961										
0010	678	119	797	482	62	216	1784	178	2722	3519
0020	670	69	739	37	69	197	2218	474	2995	3734
0030	247	228	475	0	70	72	348	445	935	1410
0040	385	20	405	0	50	398	645	311	1404	1809
0050	26	407	433	0	73	155	181	185	594	1027
0060	165	347	512	0	41	105	345	993	1484	1996
1963										
0010	745	109	854	439	93	247	2308	354	3441	4295
0020	650	96	746	0	116	448	2380	503	3447	4193
0030	242	245	487	0	94	202	477	438	1211	1698
0040	367	16	383	0	57	512	1011	470	2050	2433
0050	42	310	352	0	77	472	134	228	911	1263
0060	170	323	493	0	35	296	338	1096	1765	2258
1965										
0010	679	84	763	371	67	202	1034	1305	2979	3742
0020	626	131	757	55	58	350	1851	1365	3679	4436
0030	263	262	525	0	29	131	0	1283	1444	1969
0040	371	72	443	0	23	434	341	1319	2117	2560
0050	47	291	338	0	118	209	0	907	1234	1572
0060	167	392	559	0	20	120	26	1600	1766	2325

TABLE 6-IV

EMPLOYEE PARKING STALLS IN THE CENTRAL BUSINESS DISTRICT

Dest Zone	Metered Curb	Free Curb	Total Curb	Metered Lot	Random	Customer Lot	Commercial Lot	Private Emp. Lot	Total Offstreet	Total Parking
						1961				
10 + 20	256	152	408	358	90	285	2761	600	4094	4502
30 + 40	120	200	320	0	83	324	685	696	1788	2108
50	5	330	335	0	50	107	125	170	452	787
60	31	281	312	0	28	72	238	914	1252	1564
						1964				
10 + 20	257	170	427	299	115	431	2613	1623	5081	5508
30 + 40	118	241	359	0	70	442	631	1615	2758	3117
50	9	243	252	0	68	235	46	523	872	1124
60	32	290	322	0	19	144	126	1240	1529	1851

TABLE 6-IV shows the number of employee stalls in each of the zones being considered in the present study.

Since the number of employees arriving by car in zone 0050 was only 438 in 1964 it was assumed that 350 of the employee stalls in zone 0050 would be occupied by employees working in the zone. The remaining stalls were divided equally and added to the number in zones 0010 + 0020 and 0060 which increased the parking in each of these zones by 219 in 1961 and 487 in 1964.

The parking ratio, which is the number of parking stalls per employee, was calculated for each of the zones as shown in TABLE 6-V. Only the employees over twenty one years of age were used in this calculation in order to obtain a comparison between 1961 and 1964.

TABLE 6-V

Parking Ratio ($\frac{\text{stalls}}{\text{employees}}$)						
Zone	Employees	1961		Employees	1964	
		Stalls	Parking Ratio		Stalls	Parking Ratio
0010 + 0020	17,980	4,721	0.263	17,322	5,995	0.345
0030 + 0040	4,400	2,108	0.480	4,738	3,117	0.658
0060	4,090	1,783	0.436	4,577	2,338	0.512

It is seen from the above table that zone 0030 + 0040 and zone 0060 have very similar parking ratios and should therefore have

similar mode splits as is the case. In these zones approximately 23 percent of the employees use transit which would leave a parking ratio of between 0.70 and one stall per driving employee. It is interesting to note that the parking ratio increased between 1961 and 1964 which should indicate a decrease in transit ridership. However, the transit patronage increased over the same period indicating that the transit service is a more important factor in the choice of mode than is parking availability. Another reason for the increased transit patronage could have been that the additional parking availability was predominately in offstreet lots which meant higher parking fees. Thus transit may have become more attractive economically.

CHAPTER VII

MODAL SPLIT ANALYSIS

Modal split diversion curves are derived to represent the mode split for an area when all factors affecting choice of mode are taken into consideration. The curves are plotted as the percentage of people using transit versus the relative travel time, with stratifications for varying levels of income, travel cost ratio and service ratio or level of service. In a study conducted in Toronto, Ontario (Hill and Dodd, 1966) eighty diversion curves were obtained representing five levels of economic status, four levels of service ratio and four levels of cost ratio. A similar modal split analysis conducted in Winnipeg, Manitoba (Metropolitan Corporation of Greater Winnipeg, 1966) resulted in twenty-four diversion curves with four levels of income, two of cost ratio and three of service ratio.

Although relative travel cost was not considered in the Edmonton analysis an attempt was made to stratify the modal split diversion curves by both the service ratio, which is the ratio of excess transit time to excess car time, and by frequency of transit service. Although the very high transit patronage in some zones can be explained by the good transit service to the zones, no general correlation of either service ratio or service frequency could be obtained.

Therefore the only stratification obtained for the modal split

diversion curves was for the economic status or house sale value of the origin zones. The house sale value was divided into \$1,000 increments for purposes of analysis with some initial grouping necessary in order to obtain a sufficient number of zones in each increment. All zones having house values of less than \$10,000 and all those between \$17,000 and \$22,000 were grouped into two increments. The four zones having house sale values of greater than \$25,000 were also considered as one group for plotting purposes. Thus ten increments of house sale value were used in the initial analysis. The increments were later grouped into larger house value ranges within which there was no difference in the individual curves. TABLE 7-I outlines the final groupings of house sale value for each destination zone as used in the analysis.

Relative Travel Time

Relative travel time for this study has been computed both as travel time ratio, which is the total transit travel time divided by the total car travel time, and by travel time difference or total transit travel time minus total car travel time in an attempt to determine the reliability of the two measures. Tabulations of the travel time ratios and travel time differences are contained in Appendix C.

Topographical Barriers

The travel time ratios and travel time differences were calculated for the south side zones using bridge penalties of 0,2,3,4 and 5 minutes which were applied to the travel time by car. Bridge penalties

TABLE 7-I

HOUSE VALUE RANGES

Travel Time Ratio	Travel Time Difference
-------------------	------------------------

Zone 0010 + 0020 (1961)

Less than \$10,000	Less than \$10,000
\$10,000 to \$14,000	\$10,000 to \$14,000
\$14,000 to \$22,000	\$14,000 to \$22,000
Greater than \$25,000	Greater than \$25,000

Zone 0010 + 0020 (1964)

Less than \$11,000	Less than \$11,000
\$11,000 to \$14,000	\$11,000 to \$14,000
\$14,000 to \$17,000	\$14,000 to \$17,000
\$17,000 to \$22,000	\$17,000 to \$22,000
Greater than \$25,000	Greater than \$25,000

Zone 0030 + 0040 (1964)

Less than \$10,000	Less than \$11,000
\$10,000 to \$11,000	\$11,000 to \$14,000
\$11,000 to \$16,000	\$14,000 to \$17,000
\$16,000 to \$22,000	\$17,000 to \$22,000
Greater than \$25,000	Greater than \$25,000

Zone 0060 (1964)

Less than \$11,000	Less than \$12,000
\$11,000 to \$15,000	\$12,000 to \$16,000
\$15,000 to \$22,000	\$16,000 to \$22,000
Greater than \$25,000	Greater than \$25,000

have been found necessary in other studies for various reasons. These penalties were required as an addition to the travel time in the "Gravity Model" formula in order to obtain a balance between the predicted number of trips and the actual number of trips. In Washington, D.C. a 5 minute bridge penalty was required for trips crossing the Potomac River because the off-peak travel times used did not accurately measure the congestion on the bridges (Bouchard and Pyers, 1965). A study in Hartford, Connecticut revealed that a bridge penalty was required for trips crossing the toll bridges on the Connecticut River (Ben, Bouchard and Sweet, 1965^a).

In plotting the 1964 mode split data for Edmonton it became obvious that a bridge penalty would be required as the zones on the South Side when plotted showed results considerably higher than the zones of equal house value on the North Side of the river as shown by the example on FIGURE 7-1. Since no bridge penalty was required for the 1961 analysis, the assumption that car travel time did not change between 1961 and 1964 was incorrect with respect to the river crossings. The increase in travel time across the bridges may be a result of more frequent congestion at the river crossings forcing drivers to allow extra time for the home-to-work journey. Since transit travel times were calculated for both 1961 and 1964, addition of the bridge penalty to the transit time was not required.

^aThe bridge penalty was mentioned in this paper and referenced to a paper by C.F. Barnes (Barnes, 1961) which appears to be a misreference since the paper by Barnes made no mention of bridge penalties or of toll bridges.

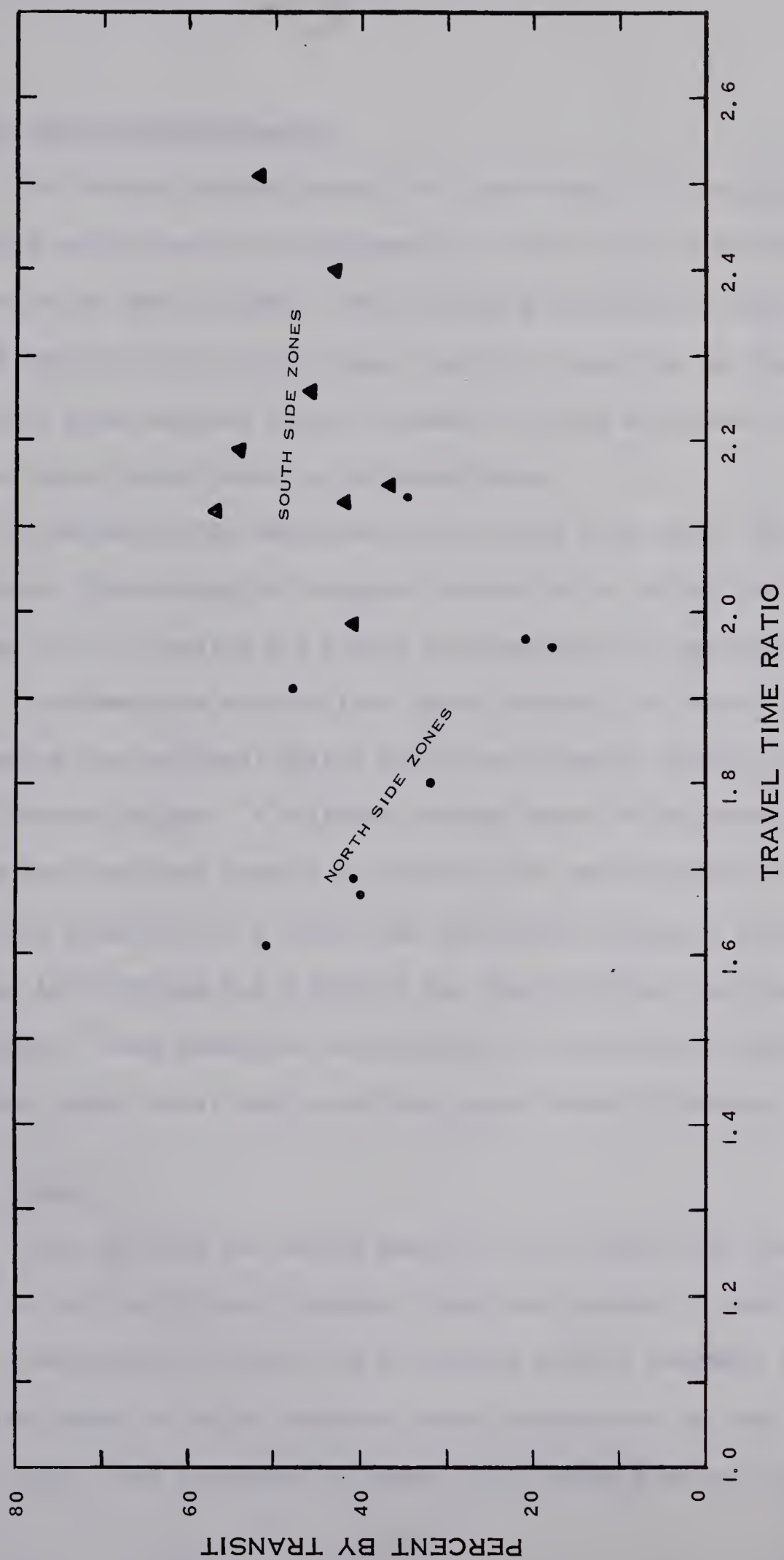


FIGURE: 7.1 A COMPARISON OF NORTH SIDE AND SOUTH SIDE ZONES DESTINED TO 0010+0020
 [HOUSE VALUE BETWEEN \$13,000 AND \$14,000]

Calculation of the Bridge Penalty

The required bridge penalty was determined by plotting all zones within each house value increment for each of the three Central Business District destinations. Three bridge penalties were thus determined for each South Side origin zone by calculating the additional travel time required by car to make the south side zones compare to those of equal house value on the north side.

In comparing the penalties of the south side zones, destination zone, distance from bridge and economic status had no effect but the bridge used in the crossing did affect the magnitude of the bridge penalty. The zones were divided into those crossing the Dawson Bridge, those crossing the Low Level Bridge and those crossing the High Level or the 105 Street Bridge. A weighted average based on the number of trips from each zone was used in calculating the penalties with the results being penalties of 1 minute for the Dawson Bridge, 5 minutes for the Low Level Bridge and 3 minutes for the 105 Street and High Level Bridges. These penalties were applied to car travel time for the analysis using travel time ratio and travel time difference.

Grouping of Data

After applying the bridge penalty to the South Side zones for 1964 the data within each economic level was grouped in equal ranges of travel time ratio or travel time difference using a weighted average based on the number of trips from each zone as described by Hill and Von Cube, 1963. This procedure eliminates the random scatter of points

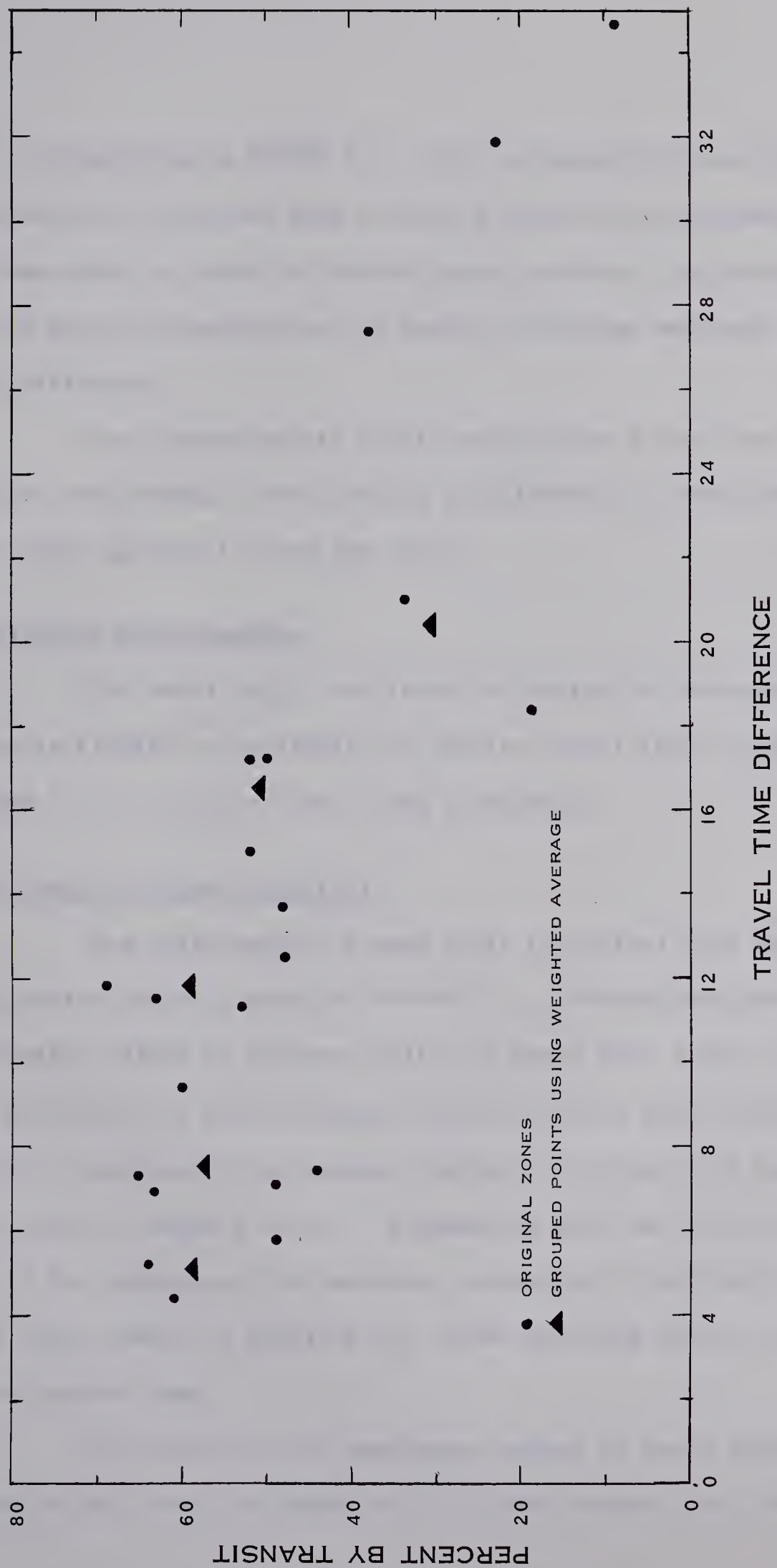


FIGURE: 7.2 THE EFFECT OF GROUPING POINTS TO ELIMINATE RANDOM SCATTER

as is illustrated on FIGURE 7-2. The increments of travel time ratio used were 0.1 but these were further grouped into increments of 0.2 in some cases in order to further reduce scatter. An increment of 2 or 4 minutes, depending on the amount of scatter, was used for travel time difference.

The grouped points within each economic level were then plotted and economic levels having no difference in the plotted points were again grouped to form one curve.

Modal Split Relationships

The modal split relationships obtained by this method are shown in FIGURE 7-3 to FIGURE 7-6 for the travel time ratio and in FIGURE 7-7 to 7-10 for travel time difference.

Modal Split by Time of Arrival

The relationship of mode split to arrival time for the three destination zones is shown in FIGURE 7-11. Parking availability has a noticeable effect on the mode splits of zones 0010 + 0020 and 0030 + 0040. The mode split is below average or only slightly above average until the choice of parking stalls becomes limited resulting in an increase in mode split at about 8:45 a.m. Although no data was available on the sex of the employees, the increase in mode split could also be caused by a large number of female store clerks arriving for the 9:30 a.m. store opening time.

The curve for the government center is quite different from those of the other two zones as it is above average until 8:00 a.m. which

is probably a result of the female government employees arriving for work. Parking does not seem to affect the mode split in this area to the extent that it does in the other two zones because the rapid increase in mode split between 8:45 and 9:00 a.m. does not occur in this zone.

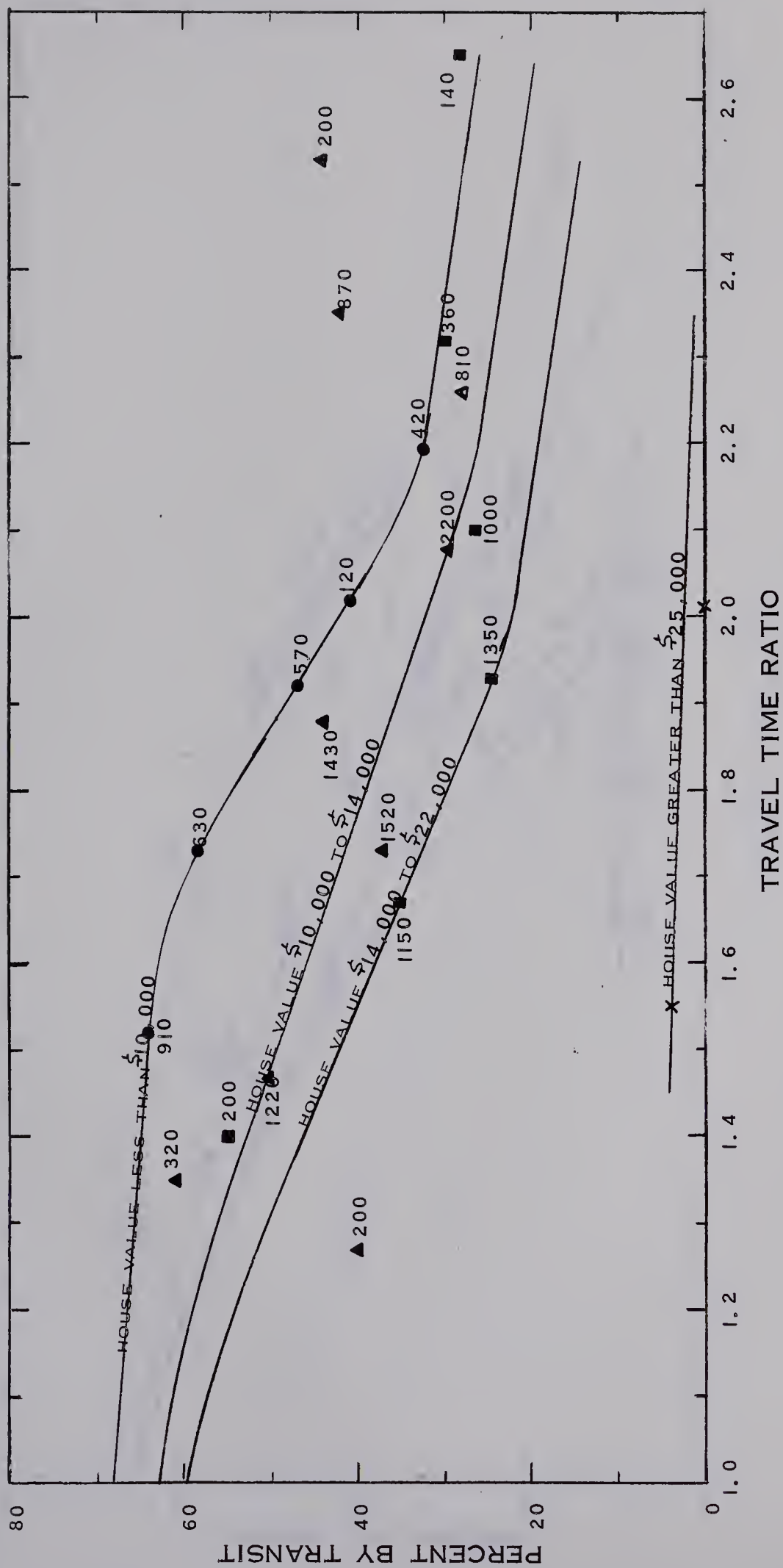


FIGURE: 7.3 1961 MODAL SPLIT RELATIONSHIPS TO ZONE 0010+0020
USING TRAVEL TIME RATIO

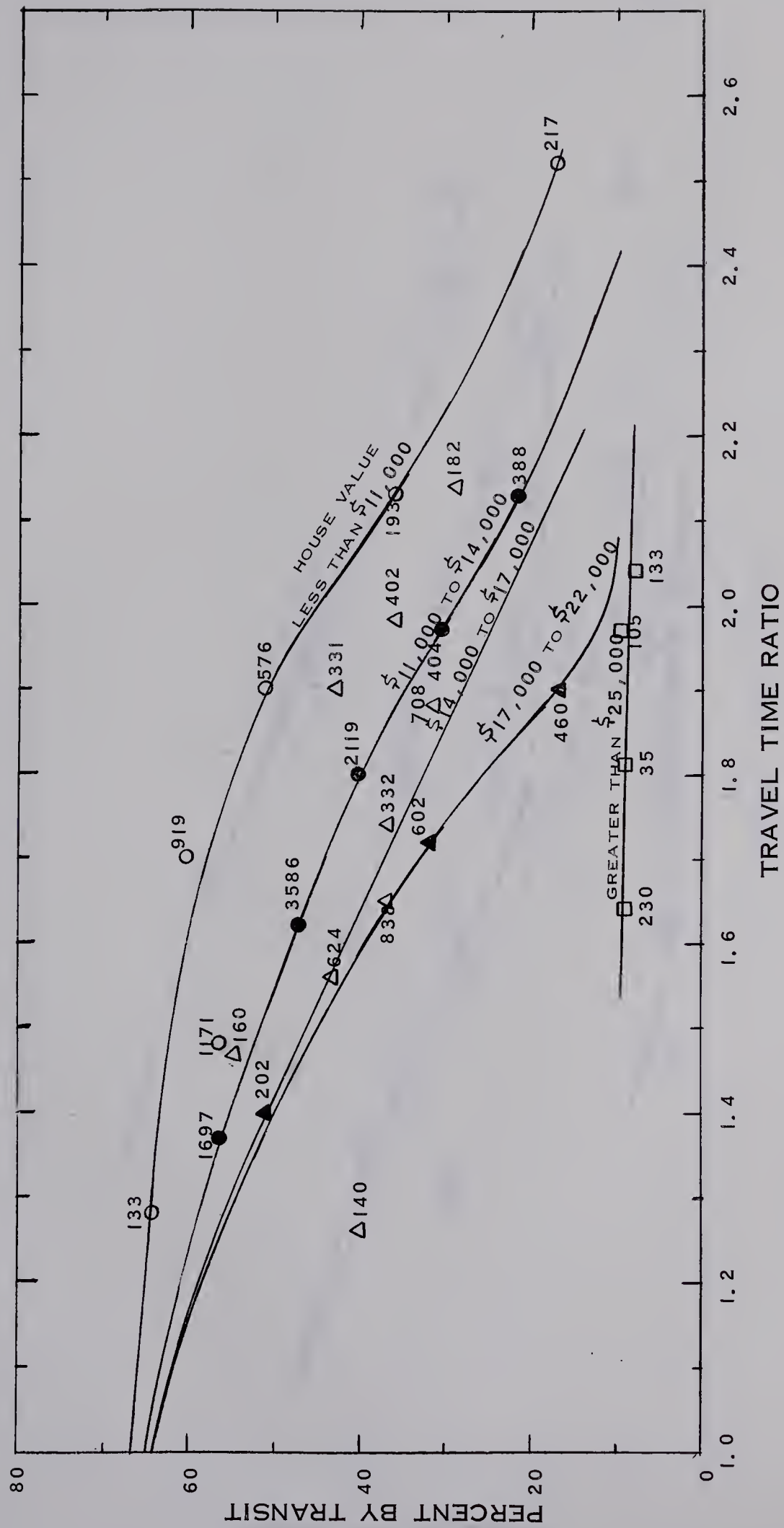


FIGURE: 7.4 1964 MODAL SPLIT RELATIONSHIPS TO ZONE 0010+0020
USING TRAVEL TIME RATIO

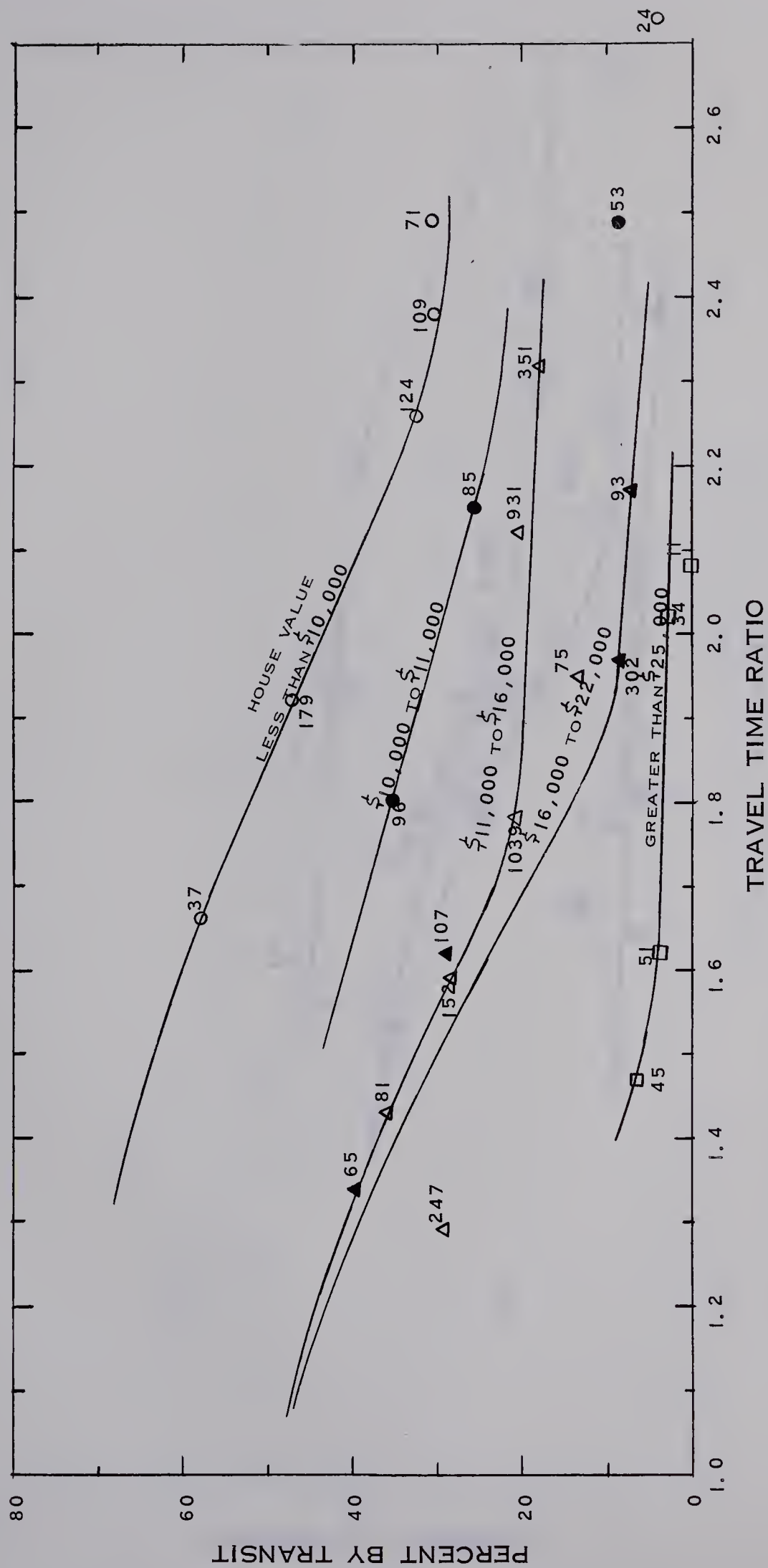


FIGURE: 7.5 1964 MODAL SPLIT RELATIONSHIPS TO ZONE 0030+0040
USING TRAVEL TIME RATIO

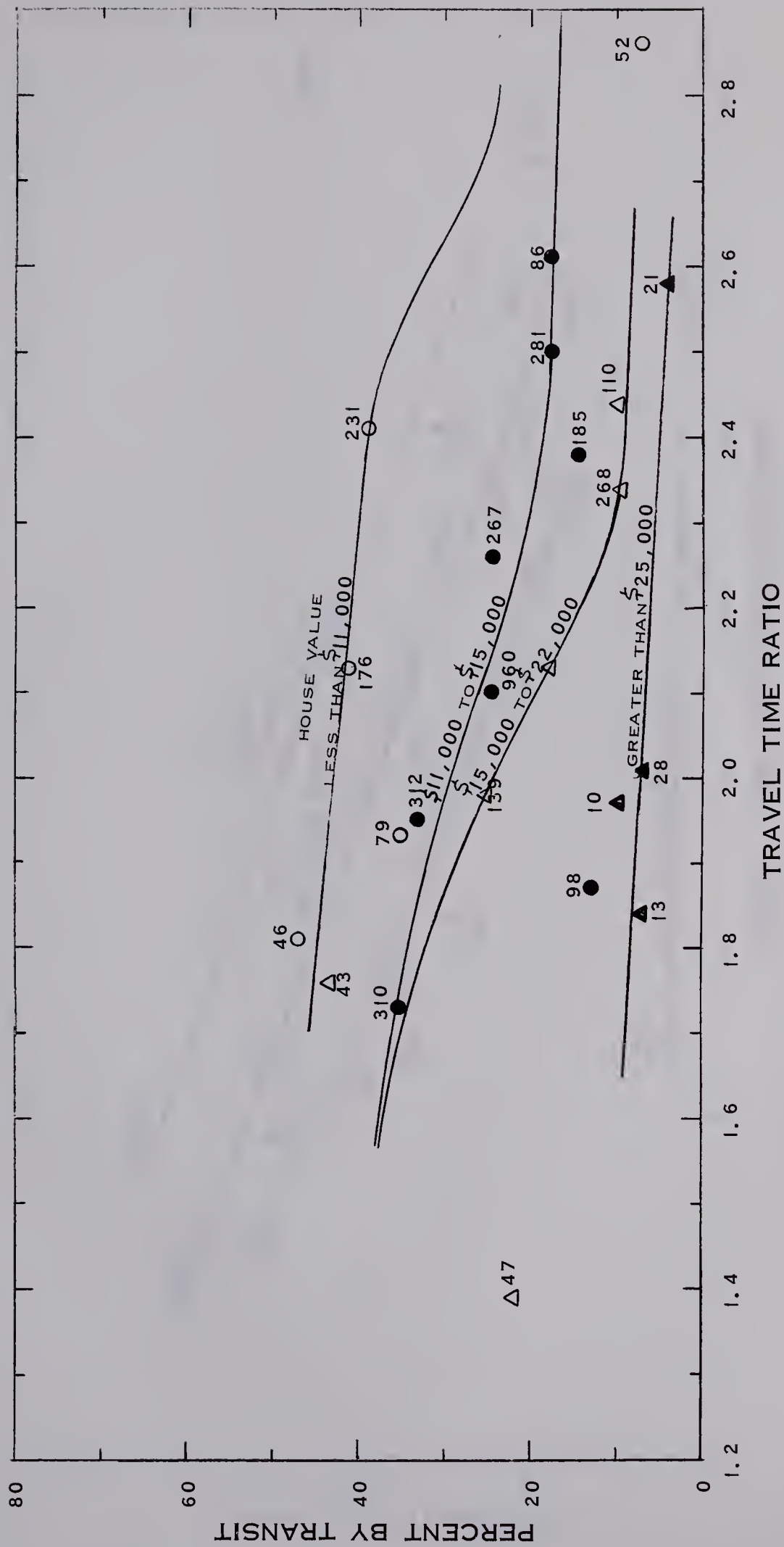


FIGURE: 7.6 1964 MODAL SPLIT RELATIONSHIPS TO ZONE 0060
USING TRAVEL TIME RATIO

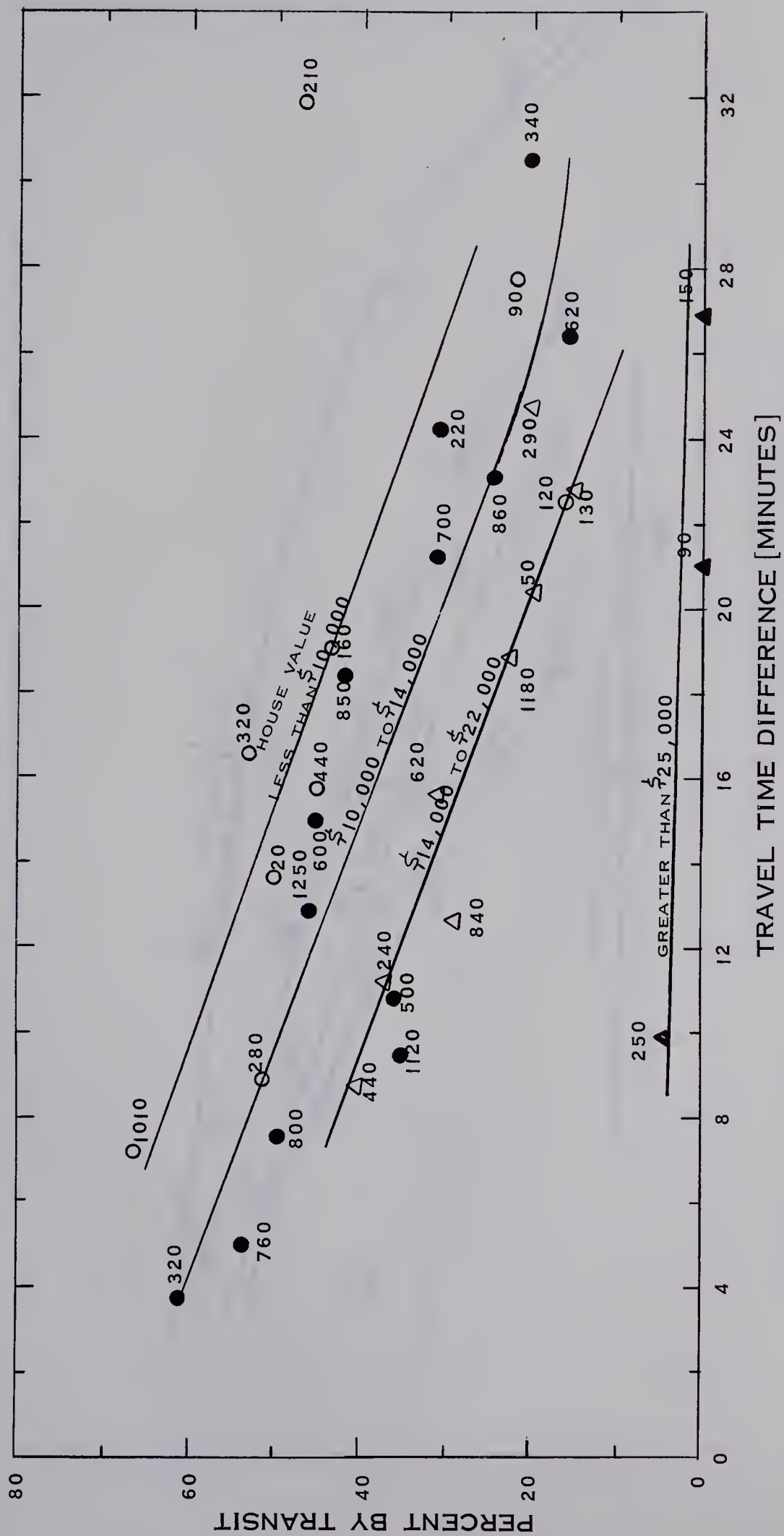


FIGURE: 7.7 1961 MODAL SPLIT RELATIONSHIPS TO ZONE 0010+0020
USING TRAVEL TIME DIFFERENCE

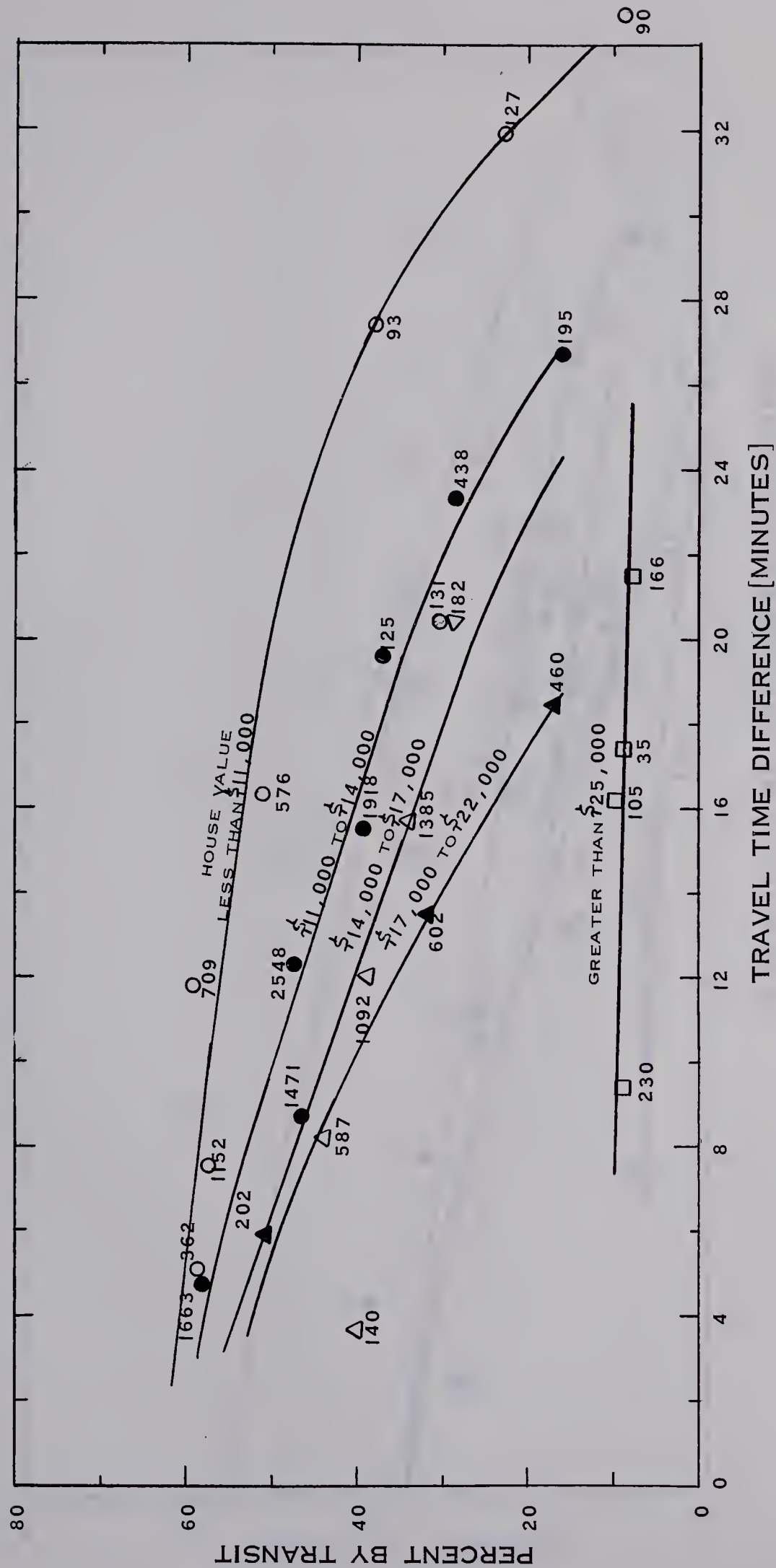


FIGURE: 7.8 1964 MODAL SPLIT RELATIONSHIPS TO ZONE 0010+0020
USING TRAVEL TIME DIFFERENCE

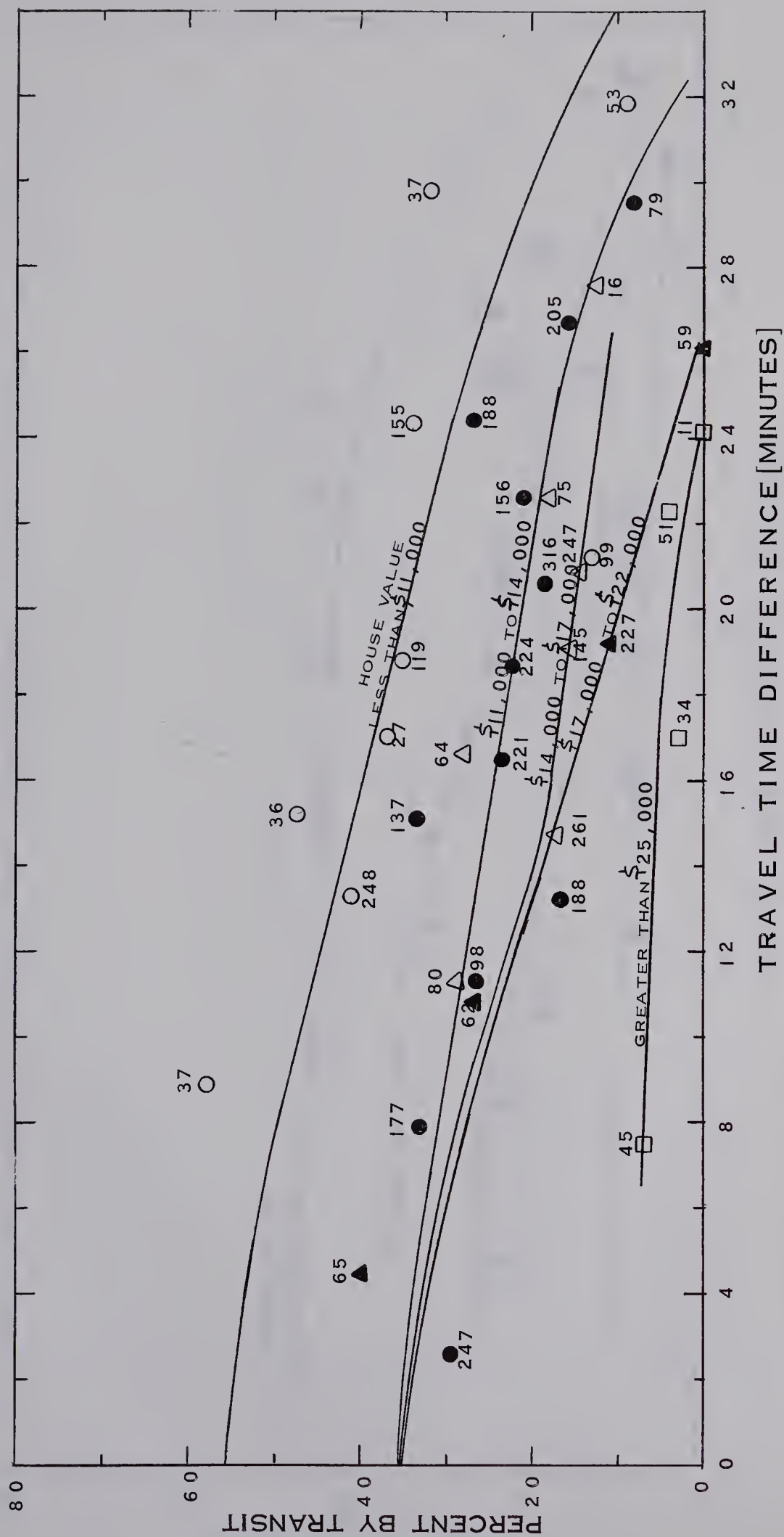


FIGURE: 7.9 1964 MODAL SPLIT RELATIONSHIPS TO ZONE 0030+0040
USING TRAVEL TIME DIFFERENCE

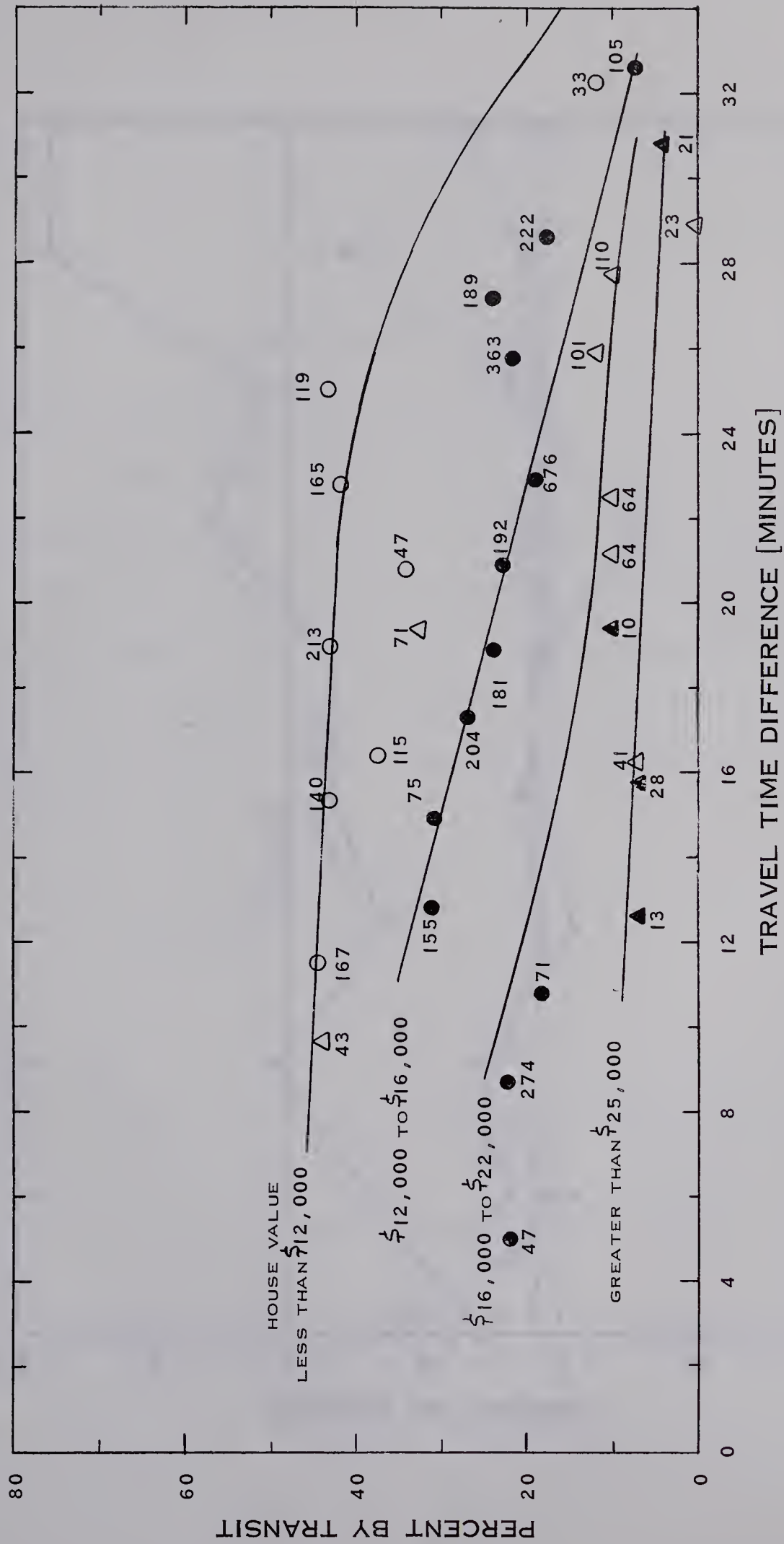


FIGURE: 7.10 1964 MODAL SPLIT RELATIONSHIPS TO ZONE 0060
USING TRAVEL TIME DIFFERENCE

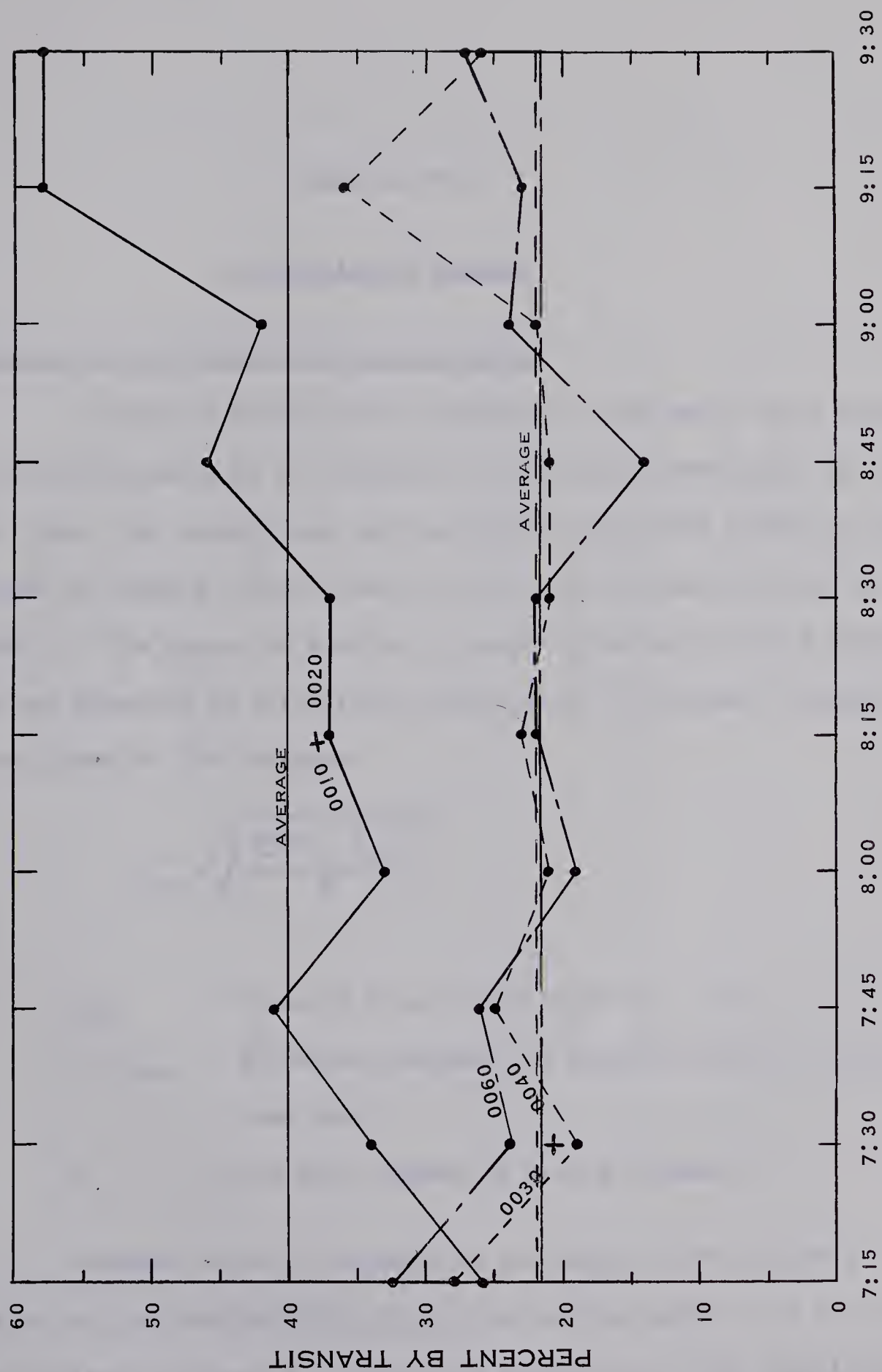


FIGURE: 7.II MODE SPLIT BY TIME OF ARRIVAL

CHAPTER VIII

DISCUSSION OF RESULTS

Reliability of the Modal Split Relationship

In order to assess the reliability of the modal split curves, the predicted mode split was compared to the actual mode split for each origin zone. The comparisons for destination zone 0010 + 0020 in 1964 are shown in TABLE 8-I while those for the other zones are shown in Appendix D. The degree of scatter of points about each of the diversion curves was measured by using the Standard Error of Estimate (Spiegel, 1961) which is given by the equation:

$$S_{yx} = \sqrt{\frac{\sum (Y - Y_{est})^2}{N}}$$

where S_{yx} = standard error of estimate of y on x
 $Y - Y_{est}$ = difference between the predicted and the actual
mode split
 N = the total number of points (zones)

Standard error of estimate is analogous to the standard deviation in that approximately 68 percent of the points will fall within a band of plus or minus S_{yx} about the given line. This equation was modified to include a measure of frequency so that the number of trips

TABLE 8-1

COMPARISON OF PREDICTED MODE SPLITS TO ACTUAL
MODE SPLITS FOR DESTINATION ZONE 0010+0020 IN 1964

Origin Zone	Actual M.S. ¹	No. of Trips	Predicted Mode Split				Origin Zone	Actual M.S.	No. of Trips	Predicted Mode Split			
			TTR ²	Diff. ³	TTD ⁴	Diff. ³				TTR	Diff.	TTD	Diff.
110	62	129	64	- 2	61	+ 1	1310	38	408	42	- 4	39	- 1
120	66	158	56	+10	57	+ 9	1320	41	303	44	- 3	41	0
140	61	142	63	- 2	60	+ 1	1330	40	227	48	- 8	46	- 6
150	63	210	60	+ 3	59	+ 4	1340	40	339	45	- 5	44	- 4
210	51	340	48	+ 3	60	- 9	1410	38	222	35	+ 3	36	+ 2
220	55	160	48	+ 7	50	+ 5	1420	43	331	28	+15	29	+14
230	51	285	35	+16	48	+ 3	1430	48	80	34	+14	33	+15
240	42	62	40	+ 2	45	- 3	1440	42	106	47	- 5	42	0
250	26	143	44	-18	46	-20	1520	50	212	51	- 1	53	- 3
260	60	185	61	- 1	58	+ 2	1540	54	175	53	+ 1	50	+ 4
310	61	178	58	+ 3	58	+ 3	1550	38	54	43	- 5	38	0
320	66	276	56	+10	58	+ 8	1620	54	183	49	+ 5	44	+10
330	44	245	55	-11	57	-13	1630	46	204	58	-12	55	- 9
340	51	202	50	+ 1	49	+ 2	2010	44	135	42	+ 2	48	- 4
410	44	158	62	-18	59	-15	2020	40	140	57	-17	54	-14
430	49	220	63	-14	59	-10	2110	64	337	54	+10	56	+ 8
440	49	259	43	+ 6	43	+ 6	2120	49	87	63	-14	59	-10
510	65	379	62	+ 3	59	+ 6	2130	54	252	47	+ 7	50	+ 4
520	63	328	56	+ 7	56	+ 7	2140	53	102	58	- 5	56	- 3
540	44	162	40	+ 4	41	+ 3	2220	10	105	9	+ 1	9	+ 1
550	52	132	50	+ 2	52	0	2230	34	148	26	+ 8	30	+ 4
560	52	232	51	+ 1	54	- 2	2250	9	35	9	0	9	0
710	48	128	59	-11	55	- 7	2310	49	180	51	- 2	52	- 3
720	57	323	46	+11	47	+10	2320	62	92	29	+33	40	+22
730	46	343	47	- 1	50	- 4	2330	41	180	46	- 5	46	- 5
810	32	206	40	- 8	42	-10	2340	54	146	39	+15	42	+12
820	18	45	31	-13	37	-19	2350	49	72	15	+34	30	+19
830	28	133	17	+11	26	+ 2	2360	33	49	17	+16	24	+ 9
840	28	57	32	- 4	37	- 9	2370	35	110	37	- 2	36	- 1
860	39	202	41	- 2	47	- 8	2410	64	133	64	0	60	+ 4
870	32	309	30	+ 2	35	- 3	2420	69	130	59	+10	56	+13
880	28	391	39	-11	43	-15	2430	43	139	45	- 2	45	- 2
910	9	230	9	0	10	- 1	2440	48	164	39	+ 9	38	+10
920	35	226	33	+ 2	32	+ 3	2450	43	72	38	+ 5	38	+ 5
930	18	363	17	+ 1	17	+ 1	2460	57	154	48	+ 9	46	+11
940	8	166	9	- 1	8	0	2470	52	195	48	+ 4	48	+ 4
960	--	--	--	--	--	--	2510	37	170	53	-16	54	-17
1010	16	195	21	- 5	17	- 1	2520	43	160	39	+ 4	42	+ 1
1020	35	103	26	+ 9	29	+ 6	2530	46	322	49	- 3	50	- 4
1030	21	173	31	-10	26	- 5	2540	52	140	39	+13	42	+10
1040	0	64	10	-10	0	0	2610	42	186	31	+11	44	- 2
1110	19	31	53	-34	52	-33	2620	48	222	45	+ 3	46	+ 2
1120	38	93	35	+ 3	38	0	2630	22	290	39	-17	39	-17
1130	48	21	59	-11	55	- 7	2640	36	402	25	+11	33	+ 3
1140	9	90	16	- 7	9	0	2710	29	238	33	- 4	33	- 4
1150	23	127	18	+ 5	23	0	2720	32	342	28	+ 4	32	0
1160	34	100	37	- 3	49	-15	3010	14	97	17	- 3	18	- 4
1170	21	90	19	+ 2	25	- 4							

¹Mode split as determined from the origin destination survey²Mode split determined from the travel time ratio curves³Actual mode split minus the predicted mode split⁴Mode split determined from the travel time difference curves

from each zone could be considered with the resulting equation being:

$$S_{yx} = \sqrt{\frac{\sum f(Y - Y_{est})^2}{N}}$$

where f = the number of trips from each zone

$Y - Y_{est}$ = same as above

N = the total number of trips

Thus the standard error of estimate as used represents a band within which 68 percent of the trips will fall.

The standard error of estimate for each set of curves is shown for each \$1,000 increment of house value in TABLE 8-II. The effect of the small sample size in 1961 is evident by the larger standard error of estimate for the 1961 relationships. In 1964 the standard error of estimate varies from 7.85 to 10.17 for travel time difference and from 8.90 to 10.32 for travel time ratio. Therefore in predicting mode splits using these curves, the predicted value will be within an absolute value of about 10 percent of the actual mode split 68 out of 100 times. There appears to be no significant difference in the results when using either travel time ratio or travel time difference as a measure of relative travel time.

Effects of Transit Route Changes

In order to measure the effect of the transit route changes on the modal split relationship, comparisons between the 1961 and 1964 re-

TABLE 8-II

STANDARD ERROR OF ESTIMATE FOR THE MODAL SPLIT RELATIONSHIPS

House Value Range (\$)	DESTINATION ZONES											
	0010 + 0020 TTR ¹	0020 TTD ²	(1961)	0010 + 0020 TTR	0020 TTD	(1964)	0030 + 0040 TTR	0040 TTD	(1964)	0060 TTR	TTD	(1964)
Less than 10,000	11.28	10.18		7.98	7.16		12.73		11.95	11.83		9.39
10,000 - 11,000	9.11	8.43		7.94	8.40		10.31		11.14	9.08		9.60
11,000 - 12,000	16.15	15.68		7.40	6.58		11.86		10.20	11.92		8.06
12,000 - 13,000	18.30	12.17		10.25	8.73		9.73		8.04	9.37		11.45
13,000 - 14,000	13.66	13.98		10.05	8.92		11.70		10.24	9.38		9.87
14,000 - 15,000	14.32	15.70		11.06	10.97		8.57		9.42	11.80		11.71
15,000 - 16,000	15.62	15.74		10.27	6.95		4.87		4.95	10.00		9.83
16,000 - 17,000	23.20	17.00		3.15	1.25		6.37		8.10	12.70		11.90
17,000 - 22,000	12.90	16.85		4.06	2.86		5.48		5.86	9.72		9.08
Greater than 25,000	0.86	1.51		0.71	0.78		0.84		1.39	1.20		1.20
Total	14.54	13.37		8.90	7.85		9.88		9.12	10.32		10.17

¹Standard error of estimate as determined from travel time ratio curves²Standard error of estimate as determined from travel time difference curves

relationships for zone 0010 + 0020 were made and are shown on FIGURE 8.1 for the travel time ratio relationships and on FIGURE 8.2 for the travel time difference relationships. In considering the travel time ratio relationships there appears to be very little difference between the 1961 and the 1964 curves except for the curve of house value greater than \$25,000 where the 1961 curve is much lower. However, in the travel time difference relationships the mode split curves in 1964 for zones having a house value of less than \$11,000 as well as those greater than \$25,000 are considerably above those in 1961. In considering the plotted points on the original curves it is doubtful if the difference between these curves could be significant since sixteen of the twenty-two zones for the 1964 curve and ten of fifteen for the 1961 curve had travel time differences of less than 18 minutes. Of the points with travel time differences greater than 18 minutes, zones 1110 and 1160 were omitted in 1964 for being too low and zone 1520 was omitted in 1961 for being too high.

Although the changes in the transit system did not affect the modal split relationships, they did increase the mode split from particular areas where transit travel time was considerably decreased. The increase in mode split caused by express buses is evident in zones 710, 1310, 1320, 1330, 1340, 1410, 1420, 1430 and 1440 where the transit travel time was decreased by as much as twelve minutes and the overall mode split increased from 26.8 percent to 40.5 percent. In using the \$11,000 to \$14,000 curve from FIGURE 7-8, the increase in mode split

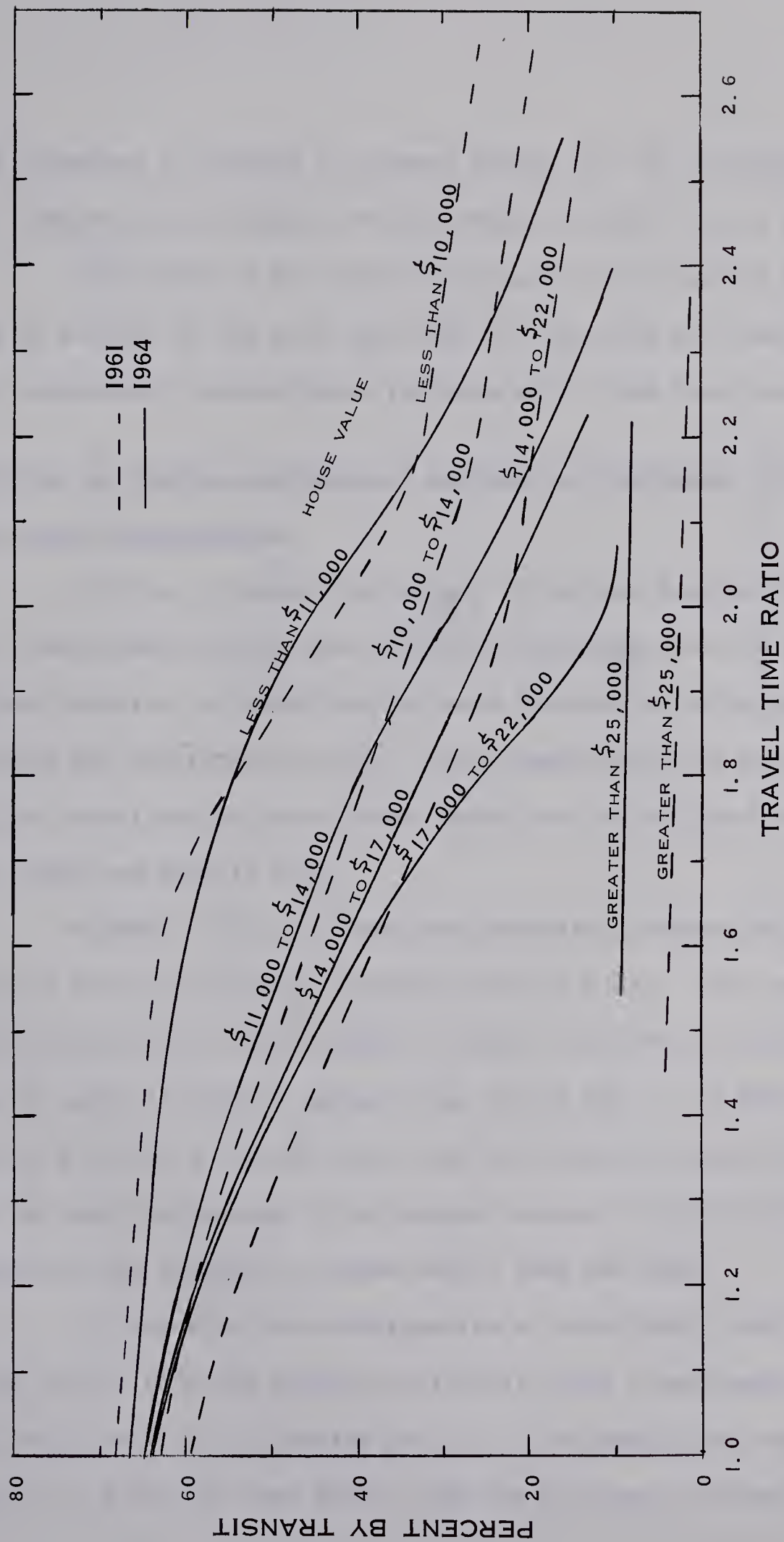


FIGURE:8.1 THE EFFECT OF TRANSIT ROUTE CHANGES ON THE MODAL SPLIT RELATIONSHIPS BY TRAVEL TIME RATIO

would represent a decrease in transit travel time of 7.5 minutes which would compare quite closely with the actual decrease in the area.

The effect of the relatively poor transit service to Jasper Place is evident by the fact that both the 1961 and the 1964 relationships consistently overestimate the mode split from this area.

The Effect of Parking Availability and Zone of Employment on the Modal Split Relationships

In order to assess the effect of parking availability and area of employment on the modal split relationships for the Central Business District, a comparison was made between the relationships of the three CBD destination zones. These comparisons were made only for the 1964 relationships since curves could not be developed for zones 0030 + 0040 and 0060 in 1961.

FIGURES 8.3 to 8.8 show the comparison between the mode split curves of the three Central Business District zones. The comparisons have been broken into four ranges of house value which include a low range of under \$11,000, a medium range of \$11,000 to \$17,000, a high range of \$17,000 to \$22,000 and a very high range of greater than \$25,000. There is some overlapping of the ranges because of the different ranges obtained in the analyses of zones 0030 + 0040 and 0060.

In comparing the relationships of zone 0010 + 0020 with those of zone 0030 + 0040 the parking availability has a noticeable effect. Zone 0030 + 0040 with a parking ratio of 0.658 stalls per employee as compared to 0.345 for zone 0010 + 0020 has mode split curves which are

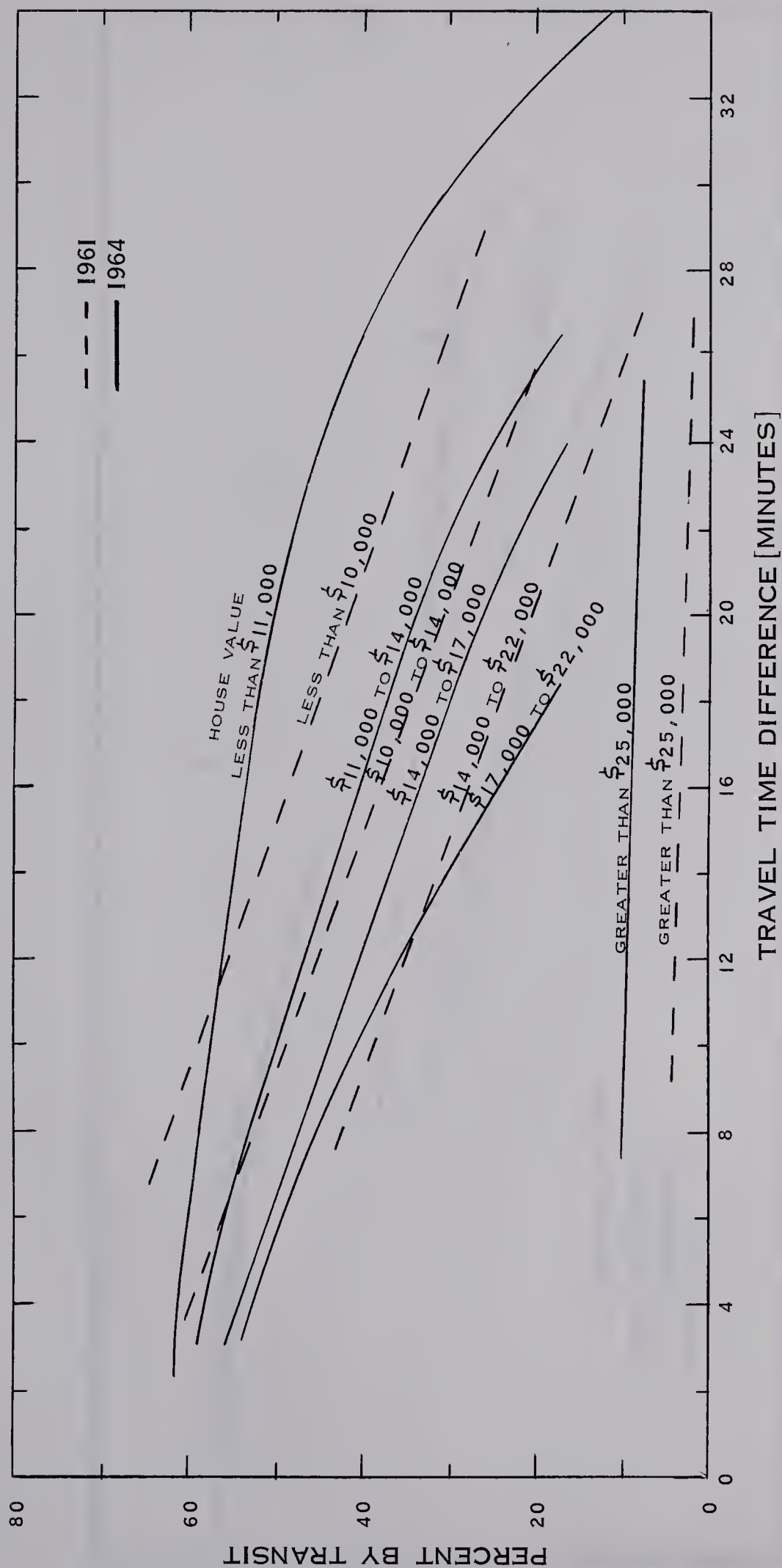


FIGURE:8.2 THE EFFECT OF TRANSIT ROUTE CHANGES ON THE MODAL SPLIT
RELATIONSHIPS BY TRAVEL TIME DIFFERENCE

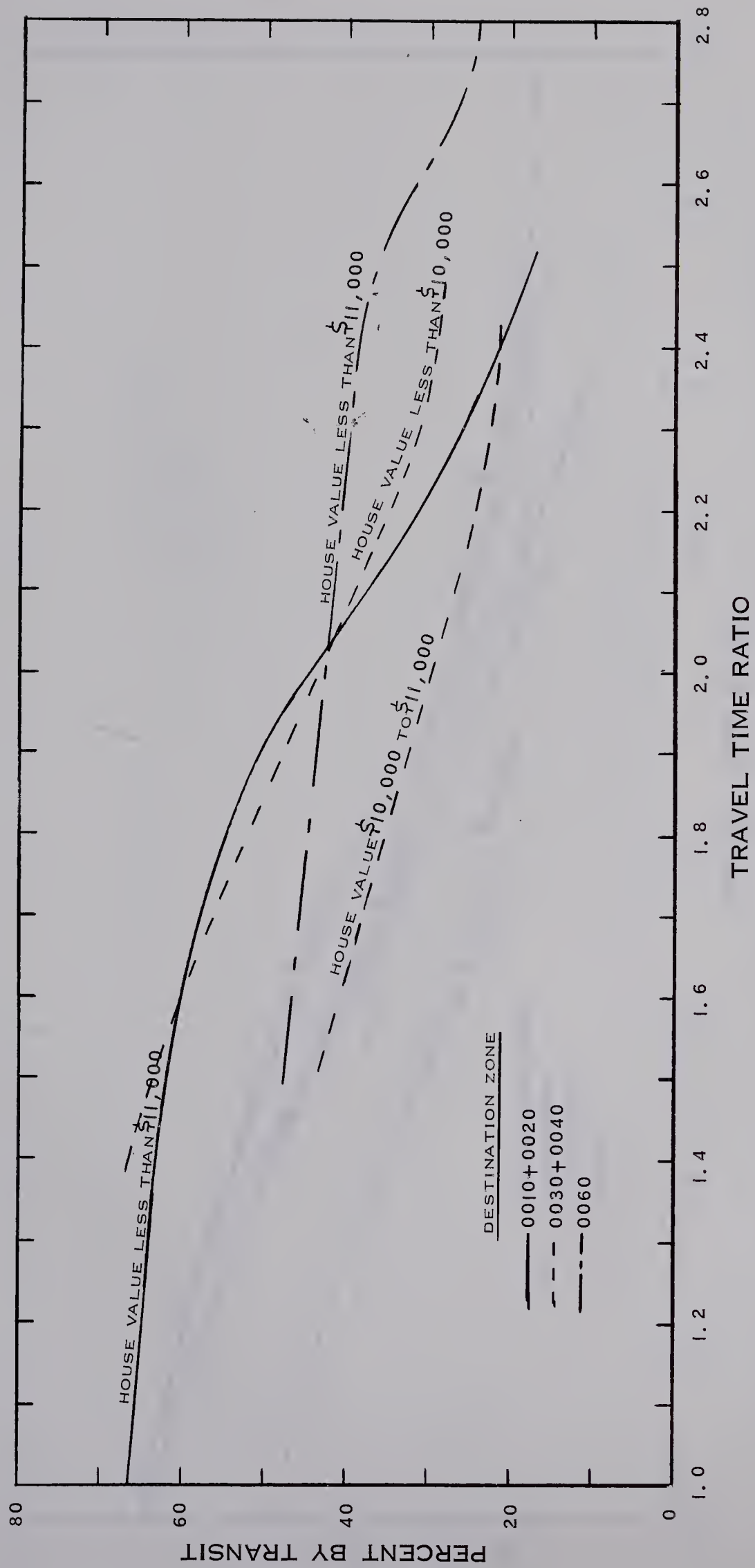


FIGURE: 8.3 THE EFFECT OF DESTINATION ZONE ON THE MODE SPLIT RELATIONSHIPS BY TRAVEL TIME RATIO FOR HOUSE VALUES OF LESS THAN \$11,000

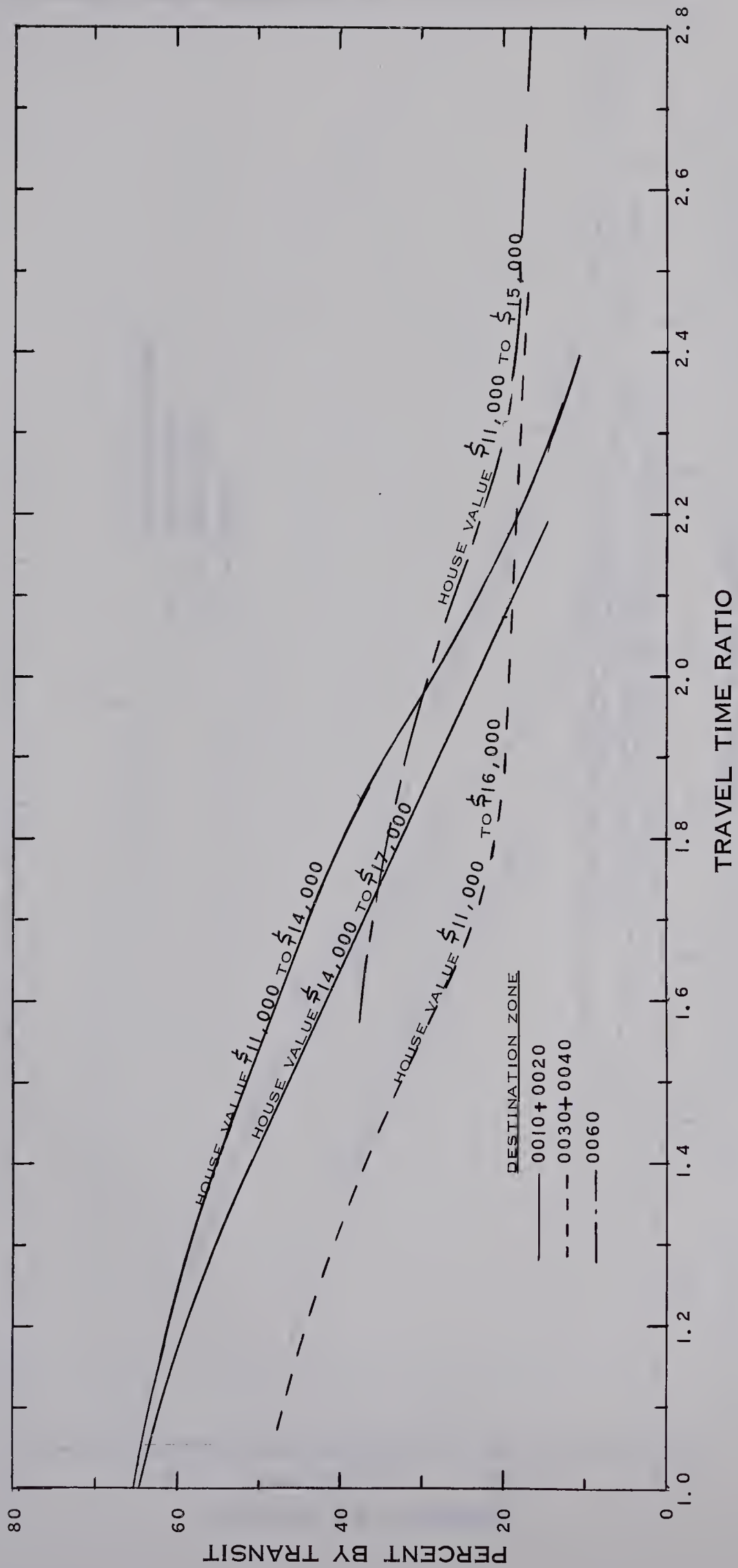


FIGURE: 8.4 THE EFFECT OF DESTINATION ZONE ON THE MODE SPLIT RELATIONSHIPS BY TRAVEL TIME RATIO FOR HOUSE VALUES BETWEEN \$11,000 AND \$17,000

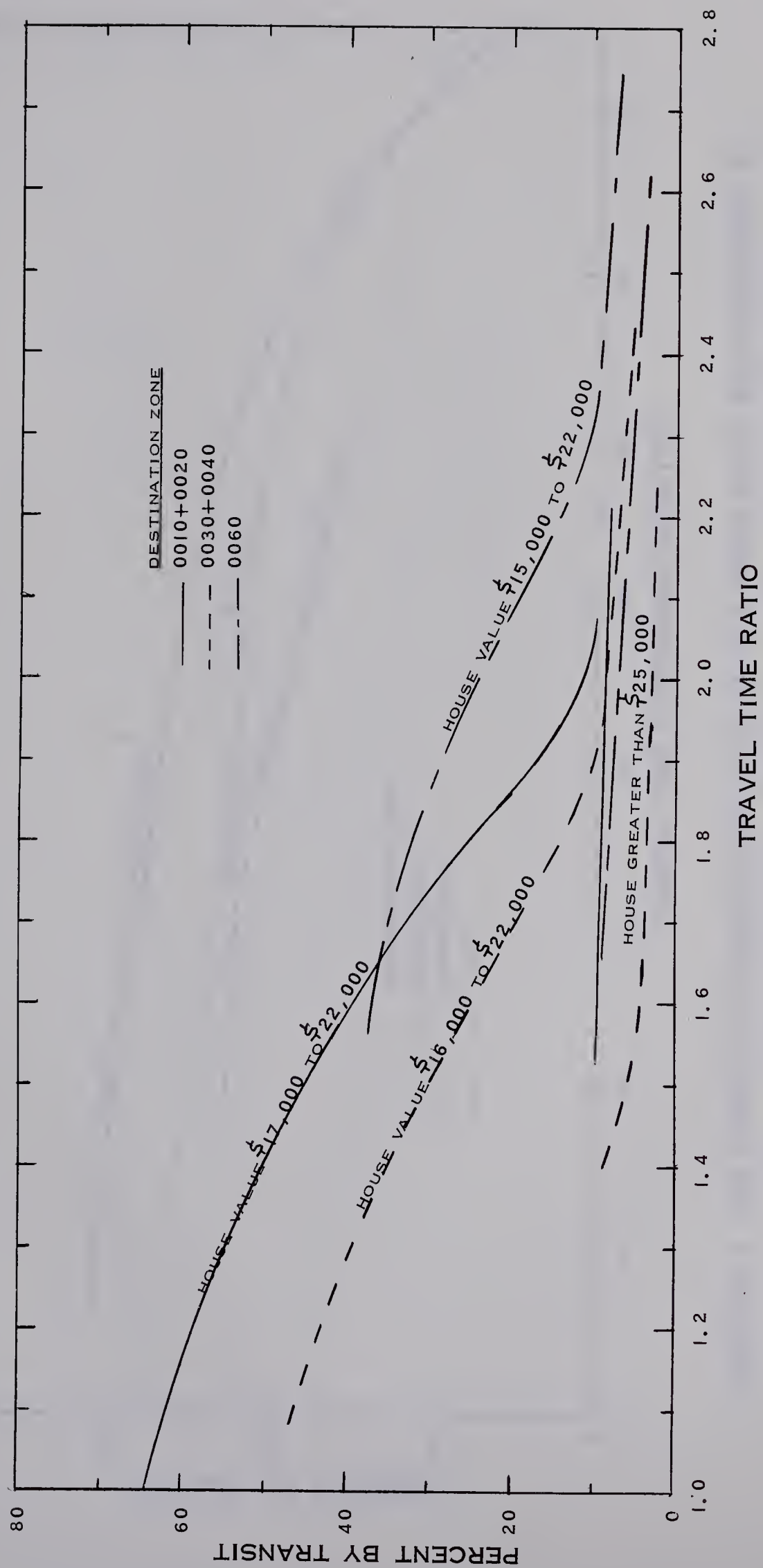


FIGURE: 8.5 THE EFFECT OF DESTINATION ZONE ON THE MODE SPLIT RELATIONSHIPS BY TRAVEL TIME RATIO FOR HOUSE VALUES GREATER THAN \$17,000

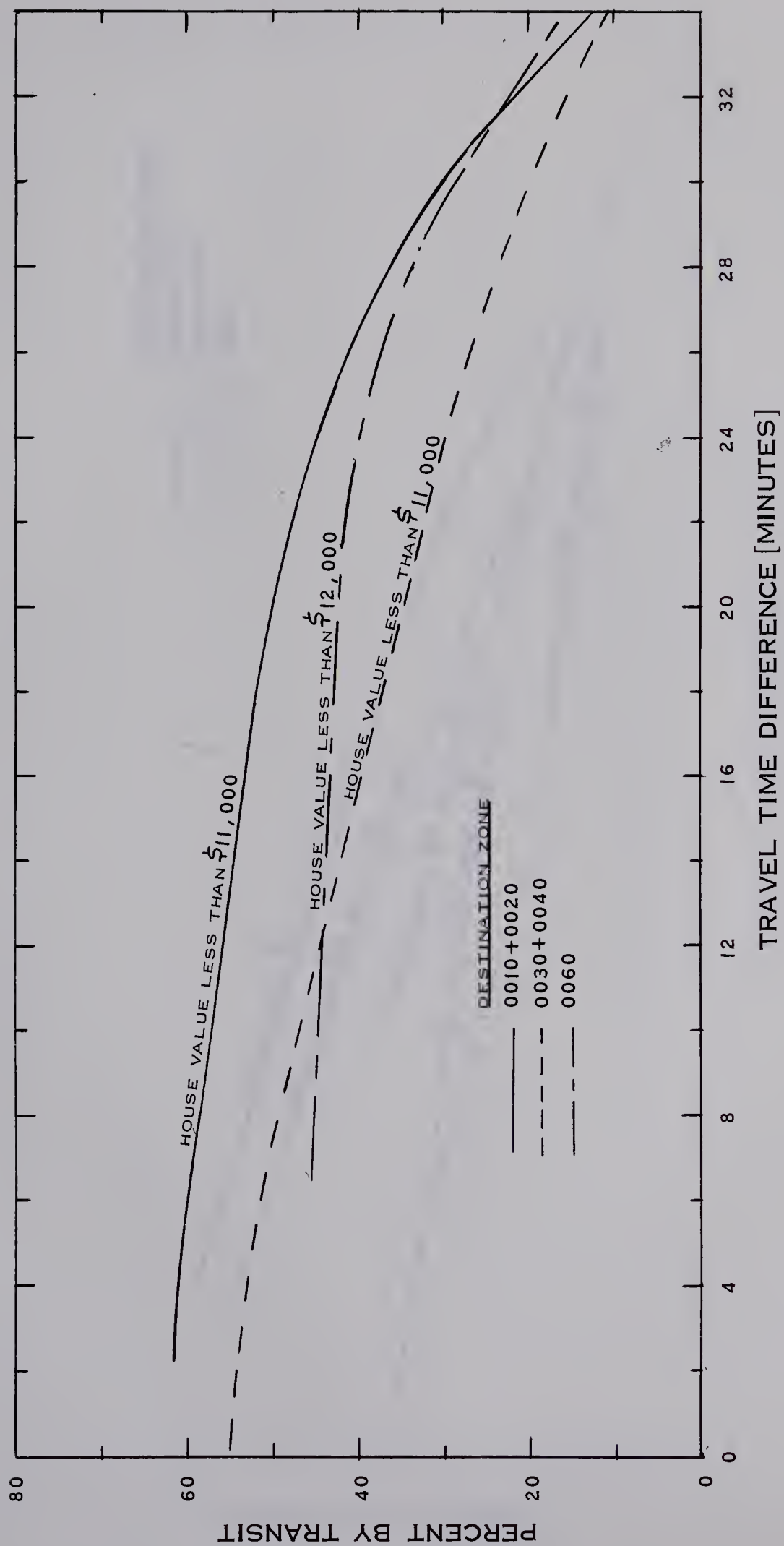


FIGURE: 8.6 THE EFFECT OF DESTINATION ZONE ON THE MODE SPLIT RELATIONSHIPS BY TRAVEL TIME DIFFERENCE FOR HOUSE VALUES OF LESS THAN \$11,000

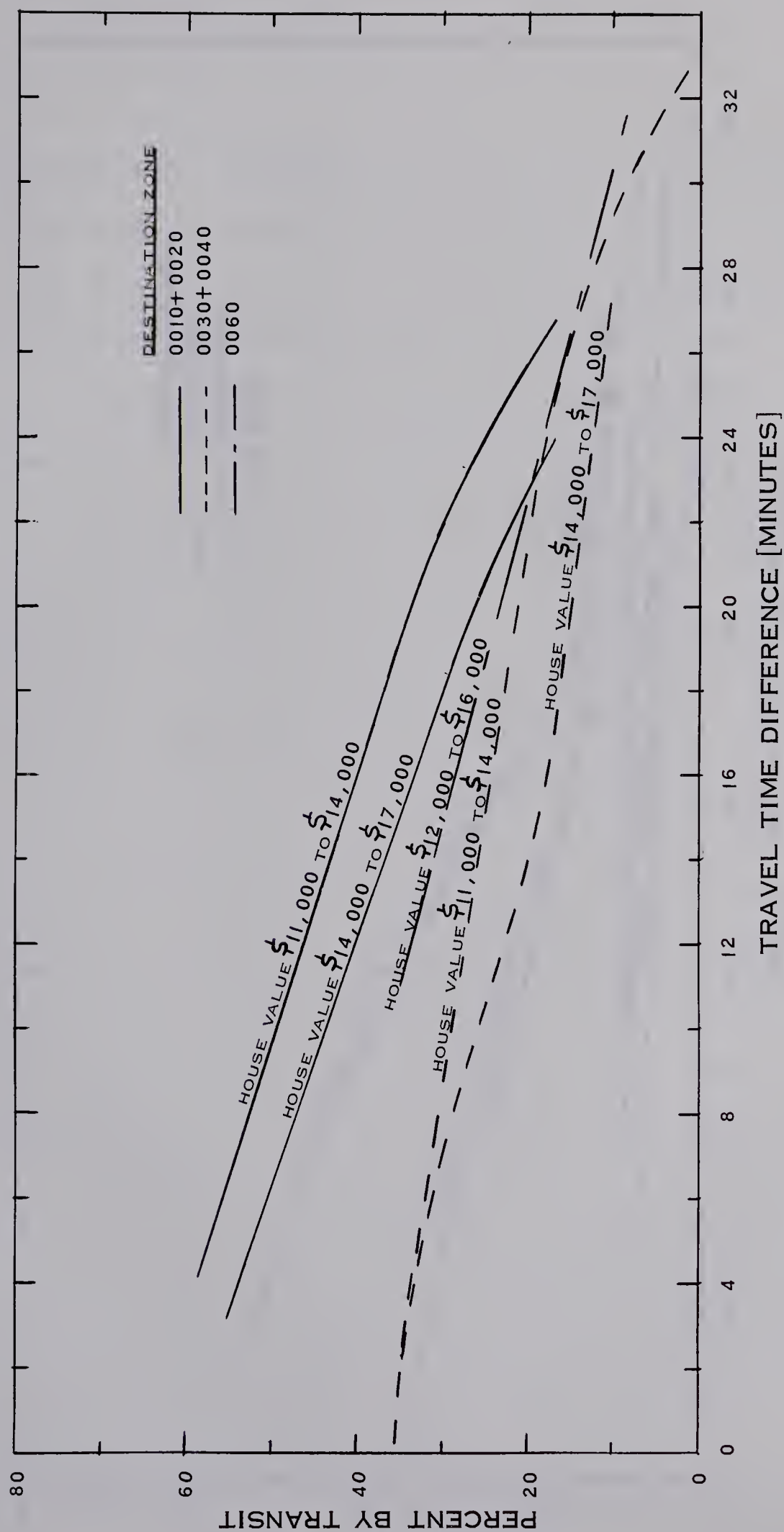


FIGURE: 8.7 THE EFFECT OF DESTINATION ZONE ON THE MODE SPLIT RELATIONSHIPS BY TRAVEL TIME DIFFERENCE FOR HOUSE VALUES BETWEEN \$11,000 AND \$17,000

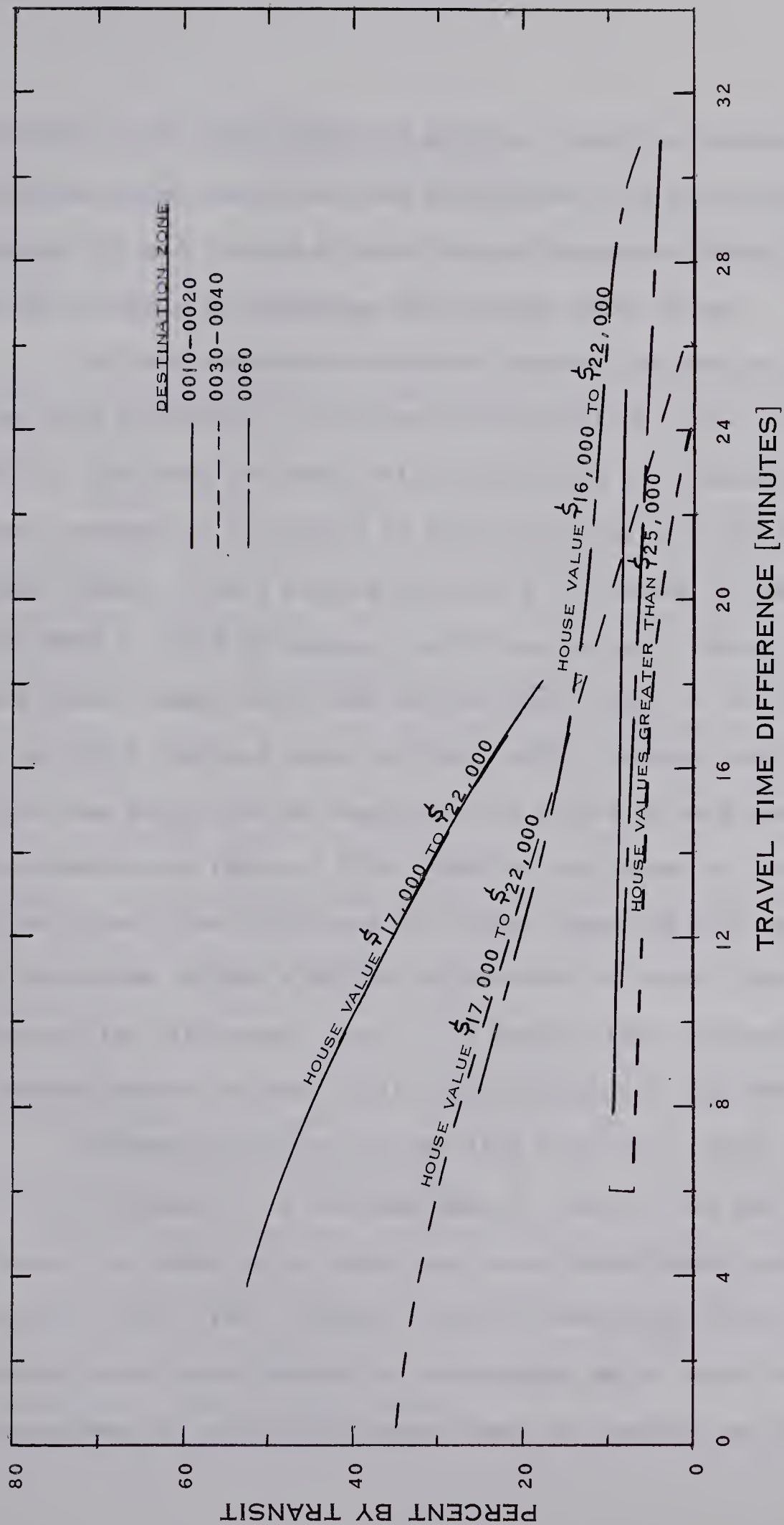


FIGURE: 8.8 THE EFFECT OF DESTINATION ZONE ON THE MODE SPLIT RELATIONSHIPS BY TRAVEL TIME DIFFERENCE FOR HOUSE VALUES GREATER THAN \$17,000

considerably lower. The effect of parking is most noticeable for low travel time ratios and travel time differences. At a travel time ratio of between 2.0 and 2.4 and a travel time difference of about 24 minutes there is virtually no difference in the mode split curves.

The most noticeable difference between the mode split curves of zone 0060 and those of the other two destination zones is that the curves for zone 0060 are much flatter indicating that government employees are less susceptible to changes in travel time than are the employees in the other zones. With a parking ratio of 0.512 stalls per employee in zone 0060 it would be expected that the mode split curves would compare quite closely with those of zone 0030 + 0040 or lie between those of 0030 + 0040 and those of 0010 + 0020. However, with the curves for this zone being flatter they cross the curves of both zones, comparing closely with those of 0030 + 0040 at low values of travel time ratio and travel time difference and either comparing with or lying above the curves of 0010 + 0020 at high values of travel time ratio and travel time difference. Thus it is evident that factors other than parking affect the mode split relationships for zone 0060.

Although the reason for the flat mode split curves for zone 0060 is not obvious, it is surmized that it results from the government center not being on the major bus routes which makes service less convenient to this area. However, special buses going directly to the government center were operated on some routes which could have made the convenience of service from areas where no transfer was required

a more important factor than relative travel time in the choice of mode. Although no figures were available, it is possible that the proportion of female employees was higher in the government center which would also tend to level out the mode split curves.

A Comparison to the Modal Split Relationships Established by the Previous Studies

In comparing the present modal split relationships to those of the Metropolitan Edmonton Transportation Study only zones 0010 + 0020 and 0030 + 0040 will be considered since the government center was not included in the METS analysis. Also the modal split relationships for house values of greater than \$25,000 will not be considered as no curves are available from the METS in this range. The comparisons are shown on FIGURE 8.9 for the four ranges of house value as used in this study. Car ownership values shown on the extremities of the shaded bands represent those corresponding to the limits of the house value ranges and were determined from FIGURE 5.6.

The curves obtained from this study agree quite closely with those of METS with the curves for destination zone 0010 + 0020 being slightly above the METS range and those for 0030 + 0040 being slightly below. The difference becomes quite noticeable at higher values of travel time difference where the METS curves level out and those of the present study become steeper. The discrepancy in this area could be caused by insufficient data for both studies.

In comparing the modal split relationships derived from the

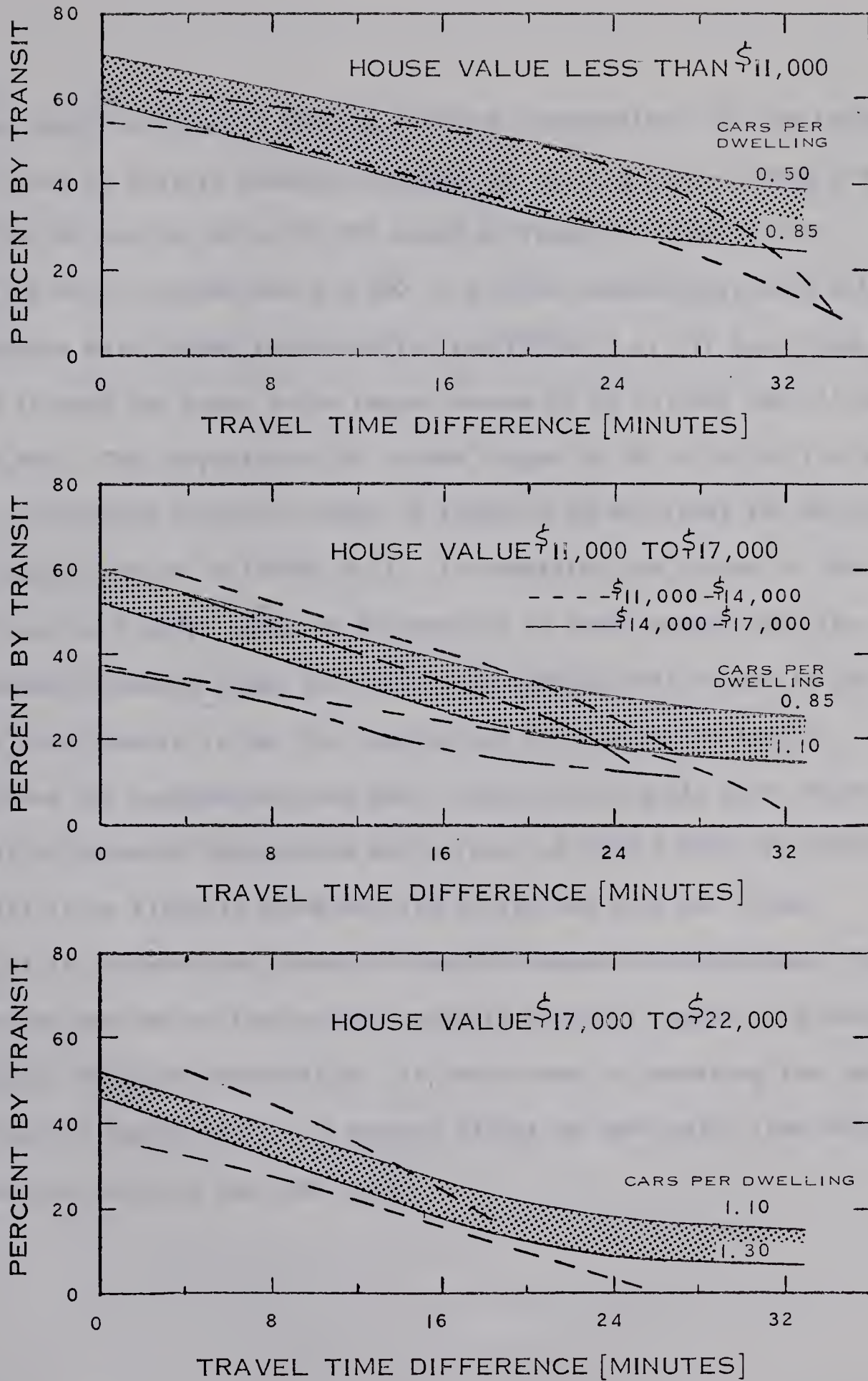


FIGURE 8.9 COMPARISON OF MODE SPLIT RESULTS TO THOSE OBTAINED FOR THE METS

NOTE: THE SHADED AREAS REPRESENT THE METS CURVES.

present study to those of Traffic Research Corporation, the two income ranges used by Traffic Research Corporation will be used. These are \$0 to \$4,500 and \$4,500 to \$5,900 which correspond to house value ranges of \$0 to \$14,600 and \$14,600 to \$19,000 respectively when using the average male income relationship from FIGURE 5.4. If total family income is used the house value ranges become \$0 to \$11,000 and \$11,000 to \$14,600. The comparisons for income ranges of \$0 to \$4,500 for all three destination zones are shown on FIGURE 8.10 and those for \$4,500 to \$5,900 are shown on FIGURE 8.11. In comparing the curves of 1964 with those of Traffic Research Corporation it would appear that the relationship between house sale value and average male income is the better relationship to use for correlating house value to income. The curves for destination zone 0010 + 0020 are slightly above those of Traffic Research Corporation while those of 0030 + 0040 are either parallel to or slightly below and the curves for 0060 are either parallel to or above the curves of Traffic Research Corporation. However, the curves derived in the present analysis generally agree with those of Traffic Research Corporation. It would seem in comparing the curves that zone of employment has a greater effect on mode split than either the service ratio or the cost ratio.

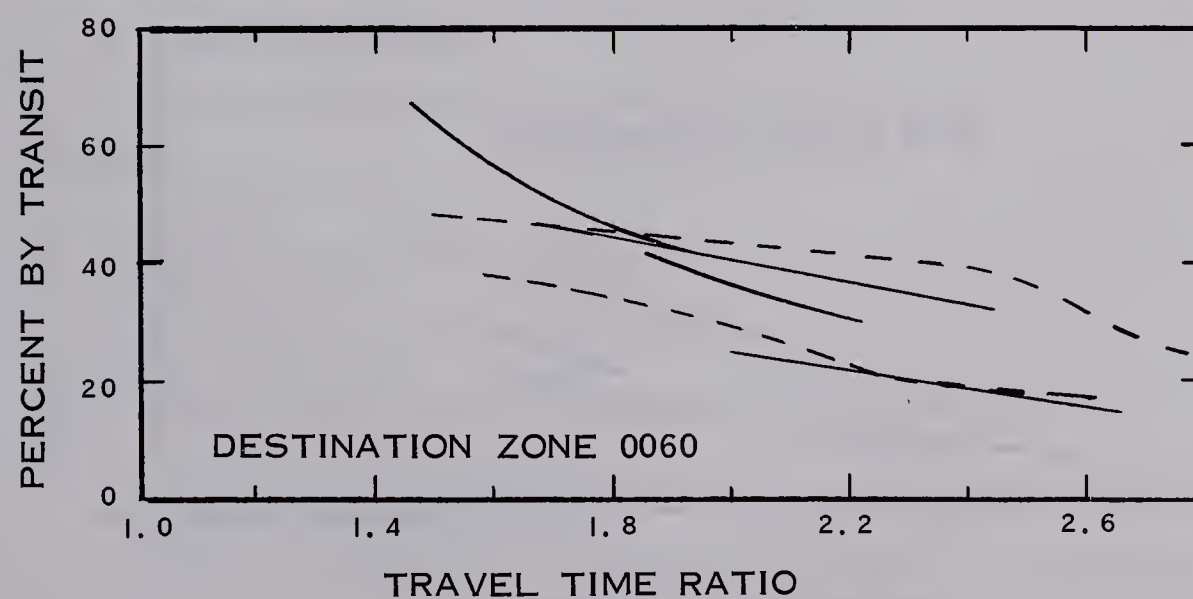
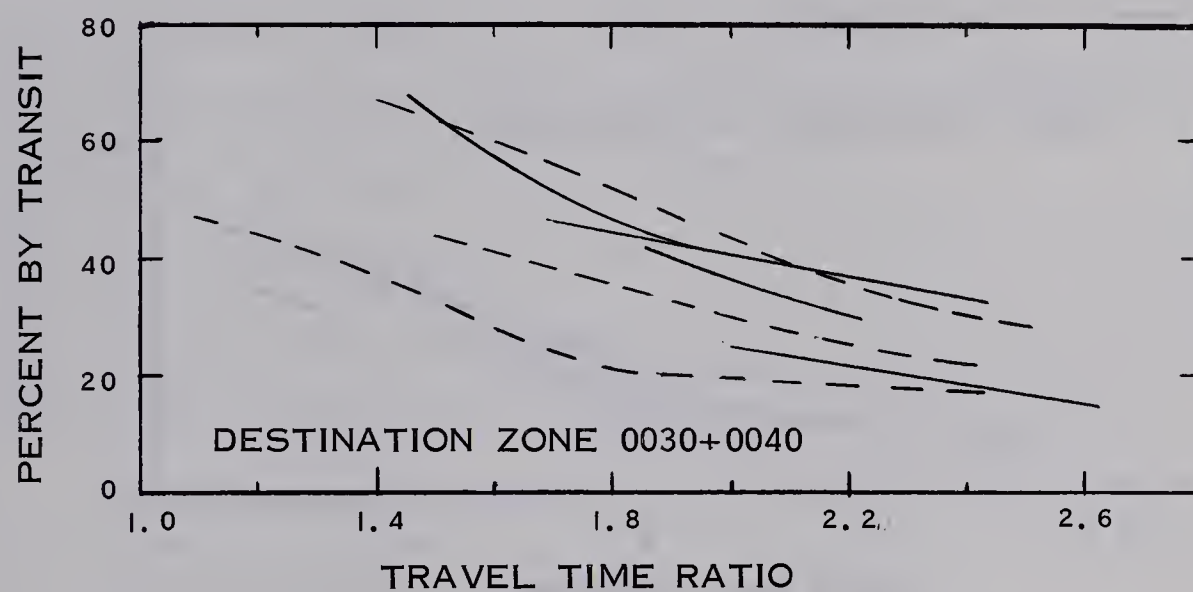
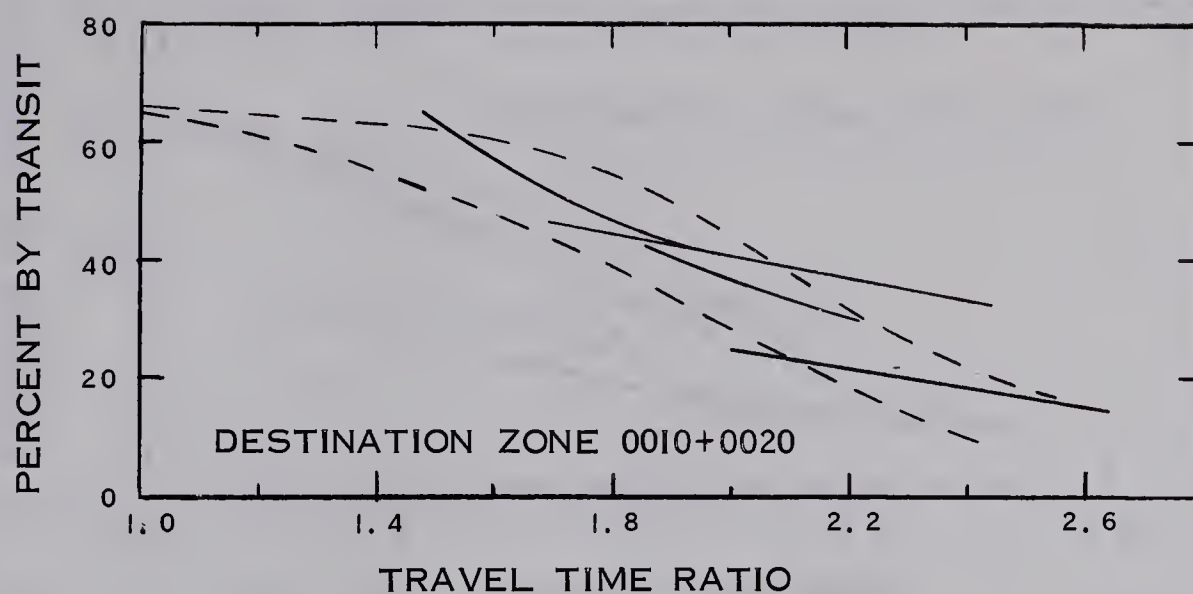


FIGURE 8.10 COMPARISON OF THE MODE SPLIT RESULTS TO THOSE OF TRAFFIC RESEARCH CORPORATION FOR INCOMES OF LESS THAN 4500 DOLLARS

TRAFFIC RESEARCH CORP. ——— PRESENT STUDY - - - - -

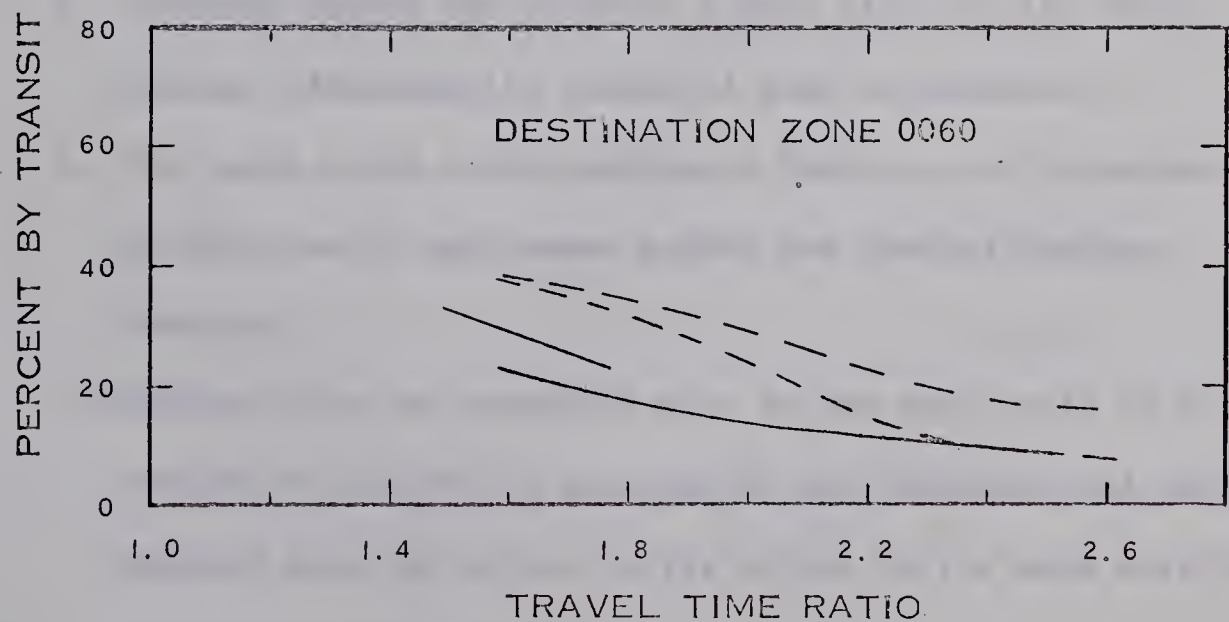
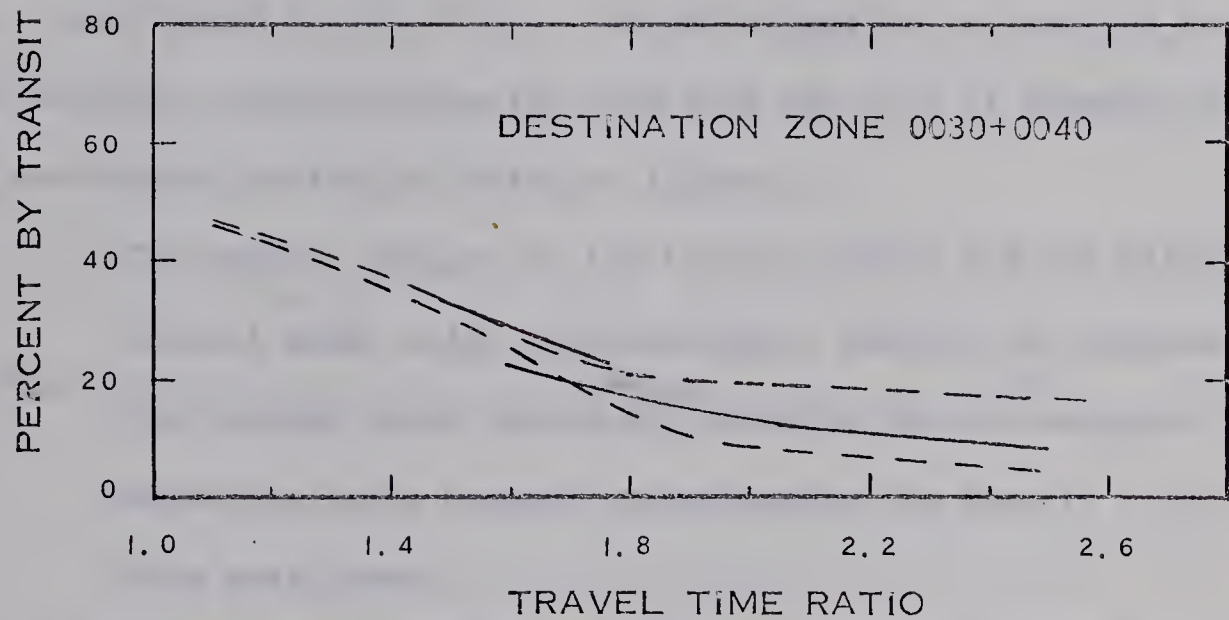
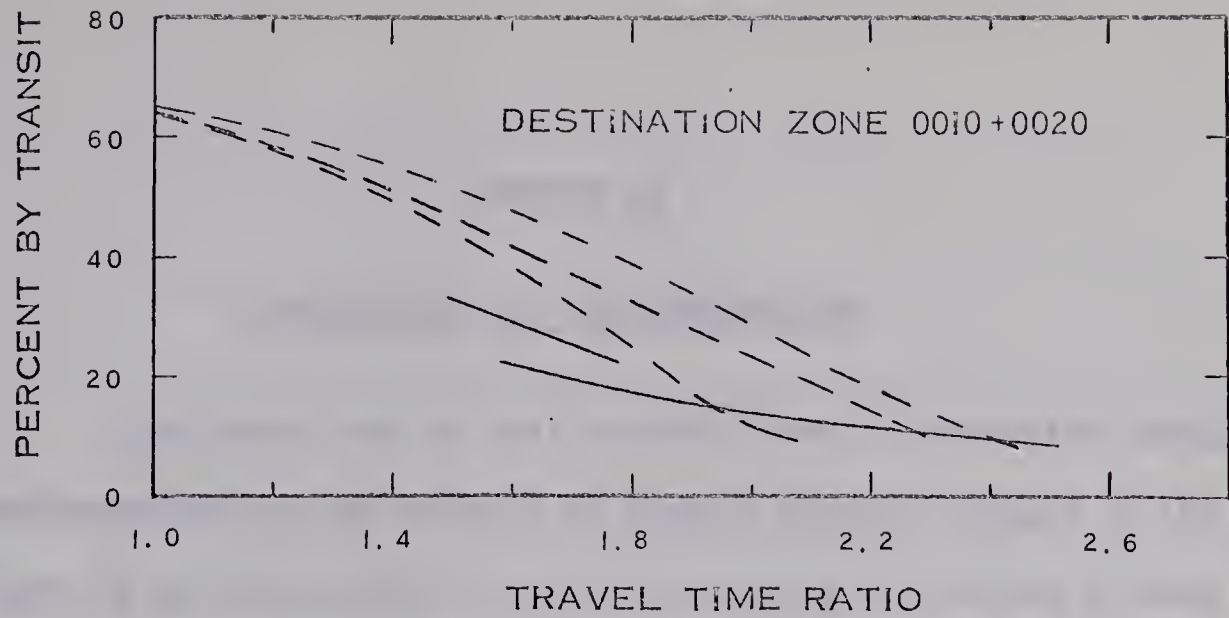


FIGURE: 8.11 COMPARISON OF MODE SPLIT RESULTS TO THOSE
OF TRAFFIC RESEARCH CORPORATION FOR INCOMES
BETWEEN \$4500 AND \$5900

CHAPTER IX

CONCLUSIONS AND RECOMMENDATIONS

The chief aims of this research were to determine changes in travel patterns and the effects of drastic transit changes on the choice of mode in an urban center. Factors affecting the choice of mode were also investigated in the study. The investigation was carried out using 1961 and 1964 origin-destination data from the City of Edmonton with the conclusions arrived at being as follows:

1. The radical changes in the transit routes did not affect the overall modal split relationships. However the changes in the transit route system did increase the percentage of employees using transit by decreasing the transit travel time from most zones.
2. Economic status and relative travel time are the chief factors affecting the choice of mode in Edmonton.
3. The modal split relationships in Edmonton are dependent on the area of employment within the Central Business District.
4. Parking plays an important role in the mode split of the commercial and office area and of the wholesale and warehousing area but it has little effect on the mode split of the government center.

5. House sale value, which is easily obtained in Edmonton, can be used as a reliable measure of economic status.
6. Relative travel time can be measured with equal reliability by both travel time difference and travel time ratio in Edmonton.

As a result of this investigation the following points are offered as recommendations:

1. It is recommended that the method adopted in this investigation for measuring the magnitude of the bridge penalty be further investigated in other centers.
2. An origin-destination survey using the same format as that of 1964 should be conducted in Edmonton to measure the effect of the following changes:
 - (a) The improved transit service to Jasper Place
 - (b) The rapid high rise development in the Central Business District
 - (c) The institution of one-way streets and other improvements to the street network.
3. Further comparisons between house sale value and other economic indicators such as income and car ownership should be made.
4. The effect of travel costs on the modal split relationships should be investigated.

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APPENDIX A

RIDING TIME CHECKS OF TRANSIT RUNNING TIME

APPENDIX A

RIDING CHECKS OF TRANSIT TRAVEL TIME

Riding checks were made on a few transit runs in August of 1966 to compare morning peak travel times to schedule times. TABLE A-1 shows the comparison between measured and schedule times for routes S2 and N6. These routes were timed on the inbound morning trip. The S2 route is within 2 minutes of the schedule time which is quite close for making only one measurement. Although the overall time measured for the N6 route was considerably higher the major difference was in the time from 129 Avenue to 127 Avenue on 127 Street. The bus was delayed for about 10 minutes in this section due to an accident. The scheduled time of 15 minutes between 127 Street and 118 Avenue and 101 Street and Jasper Avenue compares quite favorably with the measured time of 13.41 minutes considering that the driver was trying to get back on schedule during this part of the run.

TABLE A-2 shows the travel time checks made along Jasper Avenue to obtain the time from 101 Street to 107 Street of 4.0 minutes.

TABLE A-1

RIDING TRANSIT TIME CHECKS

August 1966

S2			N6		
Timing Point	Measured Time (Minutes)	Schedule Time	Timing Point	Measured Time (Minutes)	Schedule Time
109 St & 65 Ave	0	0	135 St & 135 Ave	0	0
76 Ave	4.17		132 Ave	0.67	
82 Ave	6.67	7.0	131 St & 135 Ave	1.50	
87 Ave	8.67	9.0	127 St & 135 Ave	2.83	
Bellamy Hill Road			127 St & 129 Ave	8.50	
95 Ave	12.75	14.0	127 Ave	22.50	
97 Ave	13.75		122 Ave	27.09	
99 Ave	14.67		118 Ave	30.09	19.0
101 St & Jasper	19.09	18.0	124 St & 118 Ave	31.17	
			101 St & Kingsway	37.50	
			107 Ave	38.42	
101 St & 118 Ave	0	0	104 Ave	40.42	
111 Ave	2.92	3.0	102 Ave	42.00	
Kingsway	4.50		Jasper	43.50	34.0
107 Ave	7.50	7.0			
104 Ave	9.00				
103 Ave	11.00				
102 Ave	12.50				
Jasper	14.67	13.0			

TABLE A-2

TRAVEL TIME ALONG JASPER AVENUE (Minutes)

August 1966

Timing Point	Westbound		
	Run Number		
	1	2	3
Jasper & 101 St	0	0	0
102 St	1.17	0	0.67
103 St	1.88	0.75	--
104 St	2.22	1.00	2.58
105 St	3.55	1.17	--
106 St	3.80	2.00	4.00
107 St	4.34	2.17	4.42
108 St	5.00	2.42	5.00
109 St	5.67	3.75	

Timing Point	Eastbound	
	Run Number	
	1	2
Jasper & 109 St	0	0
108 St	--	0.33
107 St	0.50	1.50
106 St	1.50	
105 St	1.67	2.25
104 St	2.17	3.20
103 St	3.00	--
102 St	3.50	4.80
101 St	4.50	6.10

APPENDIX B
TRANSIT TRAVEL TIMES

TABLE B-I

1961 TRANSIT TRAVEL TIME TO ZONE 0010+0020
(Minutes)

ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME	ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME		
110	8.0	0	2.5	2.0	2.2	6.7	14.7	1310	32.5	2.5	5.0	3.1	3.7	14.3	46.8
120	10.0	0	2.5	2.7	2.1	7.3	17.3	1320	36.5	2.5	5.0	2.6	3.7	13.8	50.3
140	10.0	0	2.5	2.7	2.0	7.2	17.2	1330	32.0	2.5	5.0	1.9	3.2	12.6	44.6
150	8.0	0	5.0	3.4	2.7	11.1	19.1	1340	28.0	2.5	5.0	3.7	3.1	14.3	42.3
210	9.5	0	2.5	3.6	1.8	7.9	17.4	1410	27.0	2.5	5.0	4.2	3.1	14.8	41.8
220	13.5	0	2.5	3.4	3.2	9.1	22.6	1420	30.0	2.5	5.0	4.2	3.1	14.8	44.8
230	13.0	0	5.0	3.9	3.3	12.2	25.2	1430	35.0	2.5	5.0	5.6	4.0	17.1	52.1
240	15.5	0	5.0	2.7	2.3	10.0	25.5	1440	33.0	2.5	5.0	2.7	3.0	13.2	46.2
250	17.5	2.5	5.0	3.9	2.8	14.2	31.7	1520	27.0	2.5	5.0	3.9	3.6	15.0	42.0
260	20.0	2.5	2.5	3.4	2.3	10.7	30.7	1540	22.0	2.5	5.0	4.9	2.2	14.6	36.6
310	7.5	0	1.3	2.9	2.3	6.5	14.0	1550	33.0	2.5	5.0	8.0	3.0	18.5	51.5
320	9.5	0	1.3	2.7	2.5	6.5	16.0	1620	17.7	3.0	5.0	6.0	2.0	16.0	33.7
330	12.0	0	1.3	2.7	2.6	6.6	18.6	1630	16.2	3.0	5.0	1.0	2.0	11.0	27.2
340	13.0	0	1.3	3.1	3.4	7.8	20.8	2010	17.0	0	5.0	4.7	3.1	12.8	29.2
410	14.0	0	3.0	3.9	3.0	9.9	23.9	2020	9.0	0	5.0	2.7	1.4	9.1	18.1
430	16.0	0	3.0	3.4	2.2	8.6	24.6	2110	11.0	0	5.0	2.0	3.1	10.1	21.1
440	20.0	0	3.0	4.8	3.0	10.8	30.8	2120	7.0	0	5.0	3.9	3.8	12.7	19.7
510	13.0	0	2.5	3.4	2.7	8.6	21.6	2130	9.0	0	5.0	3.4	4.0	12.4	21.4
520	18.0	0	3.0	3.1	2.5	8.6	26.6	2140	11.0	0	5.0	2.7	4.8	12.5	23.5
540	24.0	2.5	5.0	4.6	2.2	14.3	38.3	2220	26.5	2.5	5.0	2.6	2.3	12.4	38.9
550	23.5	2.5	5.0	4.4	2.6	14.5	38.0	2230	19.5	0	5.0	3.6	3.3	11.9	31.4
560	20.5	2.5	2.5	3.7	3.4	12.1	32.6	2250	----	---	---	---	---	----	----
710	26.5	2.5	5.0	4.4	2.5	14.4	40.9	2310	15.5	0	5.0	3.4	3.9	12.3	27.8
720	21.5	0	2.5	3.6	3.1	9.2	30.7	2320	17.0	3.0	5.0	3.6	2.7	14.3	31.3
730	16.5	0	3.0	3.4	2.9	9.3	25.8	2330	20.5	0	5.0	3.1	3.3	11.4	31.9
810	27.5	2.5	5.0	2.9	2.5	12.9	40.4	2340	18.5	0	5.0	3.6	2.2	10.8	29.3
820	29.5	2.5	5.0	4.6	1.6	13.7	43.2	2350	24.0	3.0	5.0	4.9	3.2	16.1	40.1
830	26.0	2.5	5.0	4.8	3.0	15.3	41.3	2360	----	---	---	---	---	----	----
840	26.0	2.5	5.0	2.0	2.0	11.5	37.5	2370	27.0	3.0	5.0	4.0	3.0	15.0	42.0
860	21.5	2.5	5.0	5.8	3.3	16.6	38.1	2410	14.0	3.0	5.0	3.6	2.7	14.3	28.3
870	21.5	2.5	5.0	3.9	3.5	14.9	36.4	2420	14.0	0	5.0	2.7	4.2	11.9	25.9
880	19.5	2.5	5.0	4.8	3.8	16.1	35.6	2430	16.0	0	5.0	2.7	4.8	12.5	28.5
910	16.5	0	5.0	2.6	3.7	11.3	27.8	2440	19.0	0	5.0	3.7	3.5	12.2	31.2
920	20.5	0	5.0	3.4	3.4	11.8	32.3	2450	29.0	3.0	5.0	3.6	2.7	14.3	43.3
930	22.5	2.5	5.0	6.0	3.0	16.5	39.0	2460	24.0	3.0	5.0	3.7	2.5	14.2	38.2
940	24.5	2.5	5.0	6.8	3.0	17.3	41.8	2470	21.0	3.0	5.0	3.6	3.6	15.2	36.2
960	----	---	---	---	---	----	----	2510	10.0	0	5.0	3.2	2.4	10.6	20.6
1010	31.1	5.0	5.0	8.0	1.0	19.0	50.1	2520	11.0	0	5.0	4.2	3.7	12.9	23.9
1020	25.0	5.0	5.0	7.1	2.0	19.1	44.1	2530	12.0	0	5.0	3.4	2.6	11.0	23.0
1030	29.2	5.0	5.0	8.0	1.0	19.0	48.2	2540	16.5	0	5.0	3.1	2.8	10.9	27.4
1040	29.2	5.0	5.0	7.0	2.0	19.0	48.2	2610	16.5	0	5.0	3.1	3.0	11.1	27.6
1110	22.0	5.0	5.0	5.0	2.8	17.8	39.8	2620	15.0	0	5.0	3.6	3.0	11.6	26.6
1120	34.6	5.0	5.0	3.9	2.8	16.7	51.3	2630	21.0	0	5.0	3.4	3.0	11.4	32.4
1130	16.5	5.0	5.0	5.0	2.8	17.8	34.3	2640	24.0	0	5.0	3.4	3.0	11.4	35.4
1140	38.0	5.0	5.0	6.0	3.0	19.0	57.0	2710	22.0	0	5.0	4.8	3.0	12.8	34.8
1150	36.1	5.0	5.0	4.0	3.0	17.0	53.1	2720	21.0	5.0	5.0	4.8	3.0	17.8	38.8
1160	23.4	5.0	5.0	3.0	3.2	16.2	39.6	3010	----	---	---	---	---	----	----
1170	29.2	5.0	5.0	2.0	3.2	15.2	44.4								

TABLE B-II

1961 TRANSIT TRAVEL TIME TO ZONE 0030+0040

(Minutes)

ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME	ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME		
110	12.0	0	2.5	2.0	3.8	8.3	20.3	1310	28.0	5.0	5.0	3.1	3.0	16.1	44.1
120	14.0	0	2.5	2.7	4.2	9.4	23.4	1320	32.0	5.0	5.0	2.6	3.0	15.6	47.6
140	13.0	0	2.5	2.7	1.0	6.2	19.2	1330	30.0	5.0	5.0	1.9	3.0	14.9	44.9
150	12.0	2.0	5.0	3.4	3.6	14.0	26.0	1340	32.0	4.5	5.0	3.7	3.0	16.2	48.2
210	13.5	2.0	2.5	3.6	1.5	9.6	23.1	1410	30.0	4.5	5.0	4.2	3.0	16.7	46.7
220	17.5	2.0	2.5	3.4	1.5	9.4	26.9	1420	34.0	4.5	5.0	4.2	3.0	16.7	50.7
230	17.0	2.0	5.0	3.9	1.5	12.4	29.4	1430	39.0	2.5	5.0	5.6	3.0	16.1	55.1
240	14.0	2.0	5.0	2.7	1.5	11.2	25.2	1440	37.0	2.5	5.0	2.7	4.0	14.2	51.2
250	19.0	2.5	5.0	3.9	4.0	15.4	34.4	1520	31.0	2.5	5.0	3.9	3.0	15.4	46.4
260	24.0	4.5	2.5	3.4	3.0	13.4	37.4	1540	26.0	4.5	5.0	4.9	3.0	17.4	43.4
310	3.0	0	1.3	2.9	3.0	7.2	10.2	1550	37.0	2.5	5.0	8.0	4.0	19.5	56.5
320	5.0	0	1.3	2.7	4.0	8.0	13.0	1620	17.7	3.0	5.0	6.0	2.0	16.0	33.7
330	7.5	0	1.3	2.7	2.6	6.6	14.1	1630	16.2	3.0	5.0	1.0	2.0	11.0	27.2
340	8.5	0	1.3	3.1	5.1	9.5	18.0	2010	21.0	2.0	5.0	4.7	3.2	14.9	35.9
410	18.0	2.0	3.0	3.9	1.5	10.4	28.4	2020	13.0	0	5.0	2.7	3.2	10.9	23.9
430	20.0	2.0	3.0	3.4	1.5	9.9	29.9	2110	15.0	2.0	5.0	2.0	5.3	14.3	29.3
440	24.0	2.0	3.0	4.8	1.5	11.3	35.3	2120	11.0	2.0	5.0	3.9	4.0	14.9	25.9
510	17.0	0	2.5	3.4	2.8	8.7	25.7	2130	13.0	2.0	5.0	3.4	4.0	14.4	27.4
520	22.0	0	3.0	3.1	3.4	9.5	31.5	2140	15.0	2.0	5.0	2.7	4.0	13.7	28.7
540	31.0	2.5	5.0	4.6	3.8	15.9	46.9	2220	22.0	0	5.0	2.6	3.0	10.6	32.6
550	27.5	4.5	5.0	4.4	2.4	16.3	43.8	2230	22.5	2.0	5.0	3.6	3.0	13.6	36.1
560	23.5	4.5	2.5	3.7	4.3	15.0	38.5	2250	----	---	---	---	---	----	----
710	22.0	5.0	5.0	4.4	3.3	17.7	39.7	2310	19.5	2.0	5.0	3.4	3.0	13.4	32.9
720	17.0	2.5	2.5	3.6	3.6	12.2	29.2	2320	21.0	5.0	5.0	3.6	3.0	16.6	37.6
730	12.0	0	3.0	3.4	2.6	9.0	21.0	2330	24.5	2.0	5.0	3.1	3.0	13.1	27.6
810	23.0	5.0	5.0	2.9	1.6	14.5	37.5	2340	22.5	2.0	5.0	3.6	3.0	13.6	36.1
820	25.0	5.0	5.0	4.6	2.0	16.6	41.6	2350	28.0	5.0	5.0	4.9	3.0	17.9	45.9
830	23.0	2.5	5.0	4.8	2.0	14.3	37.3	2360	----	---	---	---	---	----	----
840	23.0	2.5	5.0	2.0	2.0	11.5	34.5	2370	31.0	5.0	5.0	4.0	4.0	18.0	49.0
860	17.0	2.5	5.0	5.8	2.4	15.7	32.7	2410	18.0	5.0	5.0	3.6	5.0	18.6	36.6
870	17.0	2.5	5.0	3.9	3.5	14.9	31.9	2420	18.0	2.0	5.0	2.7	5.0	14.7	32.7
880	15.0	2.5	5.0	4.8	2.0	14.3	29.3	2430	20.0	2.0	5.0	2.7	5.0	14.7	34.7
910	12.0	0	5.0	2.6	4.5	12.1	24.1	2440	23.0	2.0	5.0	3.7	5.0	15.7	38.7
920	16.0	0	5.0	3.4	2.0	10.4	26.4	2450	33.0	5.0	5.0	3.6	5.0	18.6	51.6
930	19.0	2.5	5.0	6.0	5.0	18.5	37.5	2460	28.0	5.0	5.0	3.7	5.0	18.7	46.7
940	21.0	2.5	5.0	6.8	2.0	16.3	37.3	2470	25.0	5.0	5.0	3.6	4.0	17.6	42.6
960	----	---	---	---	---	----	----	2510	14.0	2.0	5.0	3.2	4.0	14.2	28.2
1010	31.1	5.0	5.0	8.0	2.0	20.0	51.1	2520	15.0	2.0	5.0	4.2	4.0	15.2	30.2
1020	25.0	5.0	5.0	7.1	2.0	19.1	44.1	2530	16.0	2.0	5.0	3.4	4.0	14.4	30.4
1030	29.2	5.0	5.0	8.0	2.0	20.0	49.2	2540	20.5	2.0	5.0	3.1	4.0	14.1	34.6
1040	29.2	5.0	5.0	7.0	2.0	19.0	48.2	2610	20.5	2.0	5.0	3.1	3.5	13.6	34.1
1110	22.0	5.0	5.0	5.0	2.0	17.0	39.0	2620	19.0	2.0	5.0	3.6	4.0	14.6	33.6
1120	34.6	5.0	5.0	3.9	2.0	15.9	50.5	2630	25.0	2.0	5.0	3.4	3.0	13.4	38.4
1130	16.5	5.0	5.0	5.0	2.0	17.0	33.5	2640	28.0	2.0	5.0	3.4	4.2	14.6	42.6
1140	38.0	5.0	5.0	6.0	2.0	18.0	56.0	2710	26.0	2.0	5.0	4.8	4.0	15.8	41.8
1150	36.1	5.0	5.0	4.0	2.0	16.0	52.1	2720	25.0	7.0	5.0	4.8	4.0	20.8	45.8
1160	23.4	5.0	5.0	3.0	2.0	15.0	38.4	3010	----	---	---	---	---	----	----
1170	29.2	5.0	5.0	2.0	2.0	14.0	43.2								

TABLE B-III

1961 TRANSIT TRAVEL TIMES TO ZONE 0060
(Minutes)

ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME	ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME		
110	16.0	2.0	2.5	2.0	3.0	9.5	25.5	1310	32.0	5.0	5.0	3.1	1.0	14.1	46.1
120	18.0	2.0	2.5	2.7	2.6	9.8	27.8	1320	36.0	5.0	5.0	2.6	1.0	13.6	49.6
140	17.0	2.0	2.5	2.7	5.0	12.2	29.2	1330	34.0	5.0	5.0	1.9	1.0	12.9	46.9
150	16.0	2.0	5.0	3.4	1.6	12.0	28.0	1340	36.0	4.5	5.0	3.7	1.0	14.2	50.2
210	17.5	2.0	2.5	3.6	3.0	11.1	28.6	1410	34.0	4.5	5.0	4.2	2.0	15.7	49.7
220	17.5	2.0	2.5	3.4	3.0	10.9	28.4	1420	38.0	4.5	5.0	4.2	2.0	15.7	53.7
230	21.0	2.0	5.0	3.9	3.0	13.9	34.9	1430	43.0	4.5	5.0	5.6	2.0	17.1	60.1
240	18.0	2.0	5.0	2.7	2.0	11.7	29.7	1440	41.0	4.5	5.0	2.7	2.0	14.2	55.2
250	23.0	2.5	5.0	3.9	2.0	13.4	36.4	1520	35.0	4.5	5.0	3.9	3.0	16.4	51.4
260	28.0	4.5	2.5	3.4	5.0	15.4	43.4	1540	30.0	4.5	5.0	4.9	3.0	17.4	47.4
310	7.0	2.0	1.3	2.9	3.0	9.2	16.2	1550	41.0	4.5	5.0	8.0	3.0	20.5	61.5
320	9.0	2.0	1.3	2.7	3.0	9.0	18.0	1620	21.7	5.0	5.0	6.0	3.0	19.0	40.7
330	11.5	2.0	1.3	2.7	3.0	9.0	20.5	1630	20.2	5.0	5.0	1.0	3.0	14.0	34.2
340	12.5	2.0	1.3	3.1	3.0	9.4	21.9	2010	11.5	0	5.0	4.7	2.0	11.7	23.2
410	22.0	2.0	3.0	3.9	1.6	10.5	32.5	2020	8.5	0	5.0	2.7	2.0	9.7	18.2
430	24.0	2.0	3.0	3.4	3.0	11.4	35.4	2110	19.0	2.0	5.0	2.0	2.0	11.0	30.0
440	28.0	2.0	3.0	4.8	2.0	11.8	39.8	2120	15.0	2.0	5.0	3.9	4.0	14.9	29.9
510	21.0	2.0	2.5	3.4	4.0	11.9	32.9	2130	17.0	2.0	5.0	3.4	4.0	14.4	31.4
520	26.0	2.0	3.0	3.1	3.0	11.1	37.1	2140	19.0	2.0	5.0	2.7	4.0	13.7	32.7
540	35.0	4.5	5.0	4.6	2.6	16.7	51.7	2220	18.5	0	5.0	2.6	3.0	10.6	29.1
550	31.5	4.5	5.0	4.4	2.4	14.3	45.8	2230	20.5	5.0	5.0	3.6	3.0	16.6	37.1
560	27.5	4.5	2.5	3.7	2.4	13.1	40.6	2250	----	---	---	---	---	----	----
710	26.0	7.0	5.0	4.4	1.0	17.4	43.4	2310	16.5	5.0	5.0	3.4	4.0	17.4	33.9
720	21.0	4.5	2.5	3.6	1.0	11.6	32.6	2320	25.0	5.0	5.0	3.6	4.0	17.6	42.6
730	16.0	2.0	3.0	3.4	2.0	10.4	26.4	2330	21.5	5.0	5.0	3.1	4.0	17.1	38.6
810	27.0	7.0	5.0	2.9	3.0	17.9	44.9	2340	19.5	5.0	5.0	3.6	3.0	16.6	36.1
820	29.0	7.0	5.0	4.6	3.0	19.6	48.6	2350	20.5	5.0	5.0	4.9	3.0	17.9	38.4
830	27.0	4.5	5.0	4.8	3.0	17.3	44.3	2360	----	---	---	---	---	----	----
840	27.0	4.5	5.0	2.0	3.0	14.5	41.5	2370	22.5	5.0	5.0	4.0	3.0	17.0	39.5
860	21.0	4.5	5.0	5.8	5.0	20.3	41.3	2410	22.0	5.0	5.0	3.6	3.0	16.6	38.6
870	21.0	4.5	5.0	3.9	5.0	18.4	39.4	2420	22.0	2.0	5.0	2.7	3.0	12.7	34.7
880	19.0	4.5	5.0	4.8	5.0	19.3	38.3	2430	24.0	2.0	5.0	2.7	3.0	12.7	36.7
910	16.0	2.0	5.0	2.6	5.0	14.6	30.6	2440	27.0	2.0	5.0	3.7	3.0	13.7	40.7
920	20.0	2.0	5.0	3.4	5.6	16.0	36.0	2450	37.0	5.0	5.0	3.6	3.0	16.6	53.6
930	23.0	4.5	5.0	6.0	5.0	20.5	43.5	2460	32.0	5.0	5.0	3.7	3.0	16.7	48.7
940	25.0	4.5	5.0	6.8	5.0	21.3	46.3	2470	29.0	5.0	5.0	3.6	3.0	16.6	45.6
960	----	---	---	---	---	----	----	2510	18.0	2.0	5.0	3.2	4.0	14.2	32.2
1010	26.0	5.0	5.0	8.0	5.0	23.0	49.0	2520	19.0	2.0	5.0	4.2	4.0	15.2	34.2
1020	25.0	5.0	5.0	7.1	5.0	22.1	47.1	2530	20.0	2.0	5.0	3.4	3.0	13.4	33.4
1030	29.1	5.0	5.0	8.0	5.0	23.0	52.1	2540	24.5	2.0	5.0	3.1	3.0	13.1	37.6
1040	29.1	5.0	5.0	7.0	5.0	22.0	51.1	2610	24.5	2.0	5.0	3.1	3.0	13.1	37.6
1110	22.0	5.0	5.0	5.0	5.0	20.0	42.0	2620	23.0	2.0	5.0	3.6	3.0	13.6	36.6
1120	34.5	5.0	5.0	3.9	5.0	18.9	53.4	2630	29.0	2.0	5.0	3.4	3.0	13.4	42.4
1130	16.4	5.0	5.0	5.0	5.0	20.0	36.4	2640	32.0	2.0	5.0	3.4	3.0	13.4	45.4
1140	37.9	5.0	5.0	6.0	5.0	21.0	58.9	2710	30.0	2.0	5.0	4.8	3.0	14.8	44.8
1150	36.0	5.0	5.0	4.0	5.0	19.0	55.0	2720	29.0	7.0	5.0	4.8	3.0	19.8	48.8
1160	23.3	5.0	5.0	3.0	5.0	18.0	41.3	3010	----	---	---	---	---	----	----
1170	29.1	5.0	5.0	2.0	5.0	17.0	46.1								

TABLE B-IV
1964 TRANSIT TRAVEL TIME TO ZONE 0010+0020
(Minutes)

ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME	ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME
110	8.1	0	2.5	2.0 2.2	6.7	14.8	1310	28.0	0	5.0	3.1 3.7	11.8	39.8
120	9.4	0	2.5	2.7 2.1	7.3	16.7	1320	27.0	0	5.0	2.6 3.7	11.3	38.3
140	8.2	0	2.5	2.7 2.0	7.2	15.4	1330	24.0	0	5.0	1.9 3.2	10.1	34.1
150	7.0	0	5.0	3.4 2.7	11.1	18.1	1340	22.0	0	5.0	3.7 3.1	11.8	33.8
210	7.7	0	2.5	3.6 1.8	7.9	15.6	1410	22.0	0	5.0	4.2 3.1	12.3	34.3
220	11.0	0	2.5	3.4 3.2	9.1	20.1	1420	27.0	0	5.0	4.2 3.1	12.3	39.3
230	11.0	0	5.0	3.9 3.3	12.2	23.2	1430	27.9	0	5.0	5.6 4.0	14.6	42.5
240	13.8	0	5.0	2.7 2.3	10.0	23.8	1440	27.0	0	5.0	2.7 3.0	10.7	37.7
250	13.0	0	5.0	3.9 2.8	11.7	24.7	1520	22.0	2.0	5.0	3.9 3.6	14.5	36.5
260	17.5	0	2.5	3.4 2.3	8.2	25.7	1540	20.0	0	5.0	4.9 2.2	12.1	32.1
310	7.1	0	1.3	2.9 2.3	6.5	13.6	1550	26.0	0	5.0	8.0 3.0	16.0	42.0
320	8.4	0	1.3	2.7 2.5	6.5	14.9	1620	24.0	0	5.0	6.0 2.0	13.0	37.0
330	10.3	0	1.3	2.7 2.6	6.6	16.9	1630	20.1	0	5.0	0.9 2.0	7.9	28.0
340	13.0	0	1.3	3.1 3.4	7.8	20.8	2010	12.0	2.5	3.5	4.1 3.1	13.2	25.2
410	13.3	0	2.5	3.9 3.0	9.4	22.7	2020	10.0	0	4.0	2.7 1.4	8.1	18.1
430	15.7	0	2.5	3.4 2.2	8.1	23.8	2110	10.8	0	2.0	2.0 3.1	7.1	17.9
440	19.0	0	2.5	4.8 3.0	10.3	29.3	2120	9.0	0	3.0	3.9 3.8	10.7	19.7
510	14.5	0	1.3	3.4 2.7	7.4	21.9	2130	13.0	0	5.0	3.4 4.0	12.4	25.4
520	18.0	0	3.0	3.1 2.5	8.6	26.6	2140	15.0	0	5.0	2.7 4.8	12.5	27.5
540	18.5	0	5.0	4.6 2.2	11.8	30.3	2220	23.0	0	5.0	2.6 2.3	9.9	32.9
550	24.0	0	5.0	4.4 2.6	12.0	36.0	2230	20.0	0	5.0	3.6 3.3	11.9	31.9
560	22.3	0	2.5	3.7 3.4	9.6	31.9	2250	23.5	3.5	5.0	3.5 3.3	15.3	38.8
710	19.0	0	5.0	4.4 2.5	11.9	30.9	2310	15.0	0	2.5	3.4 3.9	9.8	24.8
720	21.0	0	2.5	3.6 3.1	9.2	30.2	2320	19.0	2.0	5.0	3.6 2.7	13.3	32.3
730	16.2	0	2.0	3.4 2.9	8.3	24.5	2330	19.0	0	5.0	3.1 3.3	11.4	30.4
810	23.0	0	5.0	2.9 2.5	10.4	33.4	2340	20.0	2.0	5.0	3.6 2.2	12.8	32.8
820	26.0	0	5.0	4.6 1.6	11.2	37.2	2350	24.0	2.0	5.0	4.9 3.2	15.1	39.1
830	25.0	0	5.0	4.8 3.0	12.8	37.8	2360	29.0	2.0	5.0	1.0 3.0	11.0	40.0
840	22.0	0	5.0	2.0 2.0	9.0	31.0	2370	20.0	2.0	5.0	4.0 3.0	14.0	34.0
860	14.0	0	5.0	5.8 3.3	14.1	28.1	2410	13.4	0	4.0	3.6 2.7	10.3	23.7
870	20.0	0	5.0	3.9 3.5	12.4	32.4	2420	17.0	0	5.0	2.7 4.2	11.9	28.9
880	18.0	0	5.0	4.8 3.8	13.6	31.6	2430	19.0	0	5.0	2.7 4.8	12.5	31.5
910	18.0	0	5.0	2.6 3.7	11.3	29.3	2440	21.0	0	5.0	3.7 3.5	12.2	33.2
920	21.0	0	5.0	3.4 3.4	11.8	32.8	2450	29.0	0	4.0	3.6 2.7	10.3	39.3
930	25.0	0	5.0	6.0 3.0	14.0	39.0	2460	22.4	0	4.0	3.7 2.5	10.2	32.6
940	27.5	0	5.0	6.8 3.0	14.8	42.3	2470	19.5	0	4.0	3.6 3.6	11.2	30.7
960	----	-	---	---	---	----	2510	12.0	0	5.0	3.2 2.4	10.6	22.6
1010	36.2	0	5.0	8.0 1.0	14.0	50.2	2520	14.0	0	5.0	4.2 3.7	12.9	26.9
1020	30.1	0	5.0	7.1 2.0	14.1	44.2	2530	15.0	0	5.0	3.4 2.6	11.0	26.0
1030	34.3	0	5.0	8.0 1.0	14.0	48.3	2540	22.0	0	5.0	3.1 2.8	10.9	32.9
1040	34.3	0	5.0	7.0 2.0	14.0	48.3	2610	16.0	0	5.0	3.1 3.0	11.1	27.1
1110	27.1	0	5.0	5.0 2.8	12.8	39.9	2620	14.0	0	3.8	3.6 3.0	10.4	24.4
1120	39.7	0	5.0	3.9 2.8	11.7	51.4	2630	21.2	0	5.0	3.4 3.0	11.4	32.6
1130	21.6	0	5.0	5.0 2.8	12.8	34.4	2640	22.0	0	5.0	3.4 3.0	11.4	33.4
1140	43.1	0	5.0	6.0 3.0	14.0	57.1	2710	19.0	0	5.0	4.8 3.0	12.8	31.8
1150	41.2	0	5.0	4.0 3.0	12.0	53.2	2720	22.0	0	5.0	4.8 3.0	12.8	34.8
1160	28.5	0	5.0	3.0 3.2	11.2	39.7	3010	25.0	2.0	5.0	3.0 3.0	13.0	38.0
1170	34.3	0	5.0	2.0 3.2	10.2	44.5							

TABLE B-V
1964 TRANSIT TRAVEL TIME TO ZONE 0030+0040
(Minutes)

ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME	ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME		
110	13.1	0	2.5	2.0	3.6	8.3	21.4	1310	33.0	2.0	5.0	3.1	4.0	14.1	47.1
120	14.4	0	2.5	2.7	4.4	9.6	24.0	1320	31.0	2.0	5.0	2.6	4.0	13.6	44.6
140	15.2	0	2.5	2.7	2.0	7.2	22.4	1330	29.0	2.0	5.0	1.9	4.0	12.9	41.9
150	14.0	0	5.0	3.4	4.6	13.0	27.0	1340	27.0	2.0	5.0	3.7	4.0	14.7	41.7
210	12.7	2.0	2.5	3.6	2.5	10.6	23.3	1410	27.0	2.0	5.0	4.2	4.0	15.2	42.2
220	16.0	2.0	2.5	3.4	2.5	10.4	26.4	1420	32.0	2.0	5.0	4.2	4.0	15.2	47.2
230	16.0	2.0	5.0	3.9	2.5	13.4	29.4	1430	32.9	2.0	5.0	5.6	4.0	16.6	49.5
240	18.8	2.0	5.0	2.7	2.5	12.2	31.0	1440	32.0	2.0	5.0	2.7	5.0	14.7	46.7
250	16.0	2.0	5.0	3.9	5.0	15.9	31.9	1520	29.0	2.0	5.0	3.9	4.0	14.9	43.9
260	22.5	2.0	2.5	3.4	4.0	11.9	34.4	1540	25.0	2.0	5.0	4.9	4.0	15.9	40.9
310	2.1	0	1.3	2.9	4.0	8.2	10.3	1550	31.0	2.0	5.0	8.0	5.0	20.0	51.0
320	3.4	0	1.3	2.7	5.0	9.0	12.4	1620	29.0	2.0	5.0	6.0	3.0	16.0	45.0
330	5.3	0	1.3	2.7	3.6	7.6	12.9	1630	25.1	2.0	5.0	0.9	3.0	10.9	36.0
340	8.0	0	1.3	3.1	5.2	9.6	17.6	2010	17.0	2.0	5.0	4.1	4.2	15.3	32.3
410	18.3	2.0	2.5	3.9	2.5	10.9	29.2	2020	15.0	0	4.0	2.7	4.2	10.9	25.9
430	20.7	2.0	2.5	3.4	2.5	10.4	31.1	2110	15.8	2.0	2.0	2.0	5.6	11.6	27.4
440	24.0	2.0	2.5	4.8	2.5	11.8	35.8	2120	14.0	2.0	3.0	3.9	5.0	13.9	27.9
510	19.5	0	1.3	3.4	3.8	8.5	28.0	2130	18.0	2.0	5.0	3.4	5.0	15.4	33.4
520	23.0	0	3.0	3.1	4.2	10.3	33.3	2140	20.0	2.0	5.0	2.7	5.0	14.7	34.7
540	23.5	2.0	5.0	4.6	3.6	15.2	38.7	2220	22.0	0	5.0	2.6	4.0	11.6	33.6
550	29.0	2.0	5.0	4.4	3.4	14.8	43.8	2230	25.0	2.0	5.0	3.6	4.0	14.6	39.6
560	27.3	2.0	2.5	3.7	4.6	12.8	40.1	2250	30.0	4.0	5.0	3.5	4.0	16.5	46.5
710	24.0	2.0	5.0	4.4	2.6	14.0	38.0	2310	20.0	2.0	2.5	3.4	4.0	11.9	31.9
720	16.0	0	2.5	3.6	4.6	10.7	26.7	2320	26.0	2.0	5.0	3.6	4.0	14.6	40.6
730	11.2	0	2.0	3.4	3.2	8.6	19.8	2330	24.0	2.0	5.0	3.1	4.0	14.1	38.1
810	27.0	2.0	5.0	2.9	2.6	11.5	38.5	2340	27.0	2.0	5.0	3.6	4.0	14.6	41.6
820	25.0	2.0	5.0	4.6	3.0	13.6	38.6	2350	29.0	4.0	5.0	4.9	4.0	17.9	46.9
830	22.0	2.0	5.0	4.8	3.0	14.8	36.8	2360	34.0	4.0	5.0	1.0	4.0	14.0	48.0
840	20.0	2.0	5.0	2.0	3.0	12.0	32.0	2370	25.0	4.0	5.0	4.0	5.0	18.0	43.0
860	18.0	2.0	5.0	5.8	3.4	16.2	34.2	2410	18.4	2.0	4.0	3.6	6.0	15.6	34.0
870	16.0	2.0	5.0	3.9	5.0	15.9	31.9	2420	22.0	2.0	5.0	2.7	6.0	15.7	37.7
880	16.0	2.0	5.0	4.8	3.0	14.8	30.8	2430	24.0	2.0	5.0	2.7	6.0	15.7	39.7
910	13.0	0	5.0	2.6	3.0	10.6	23.6	2440	26.0	2.0	5.0	3.7	6.0	16.7	42.7
920	17.0	0	5.0	3.4	3.0	11.4	28.4	2450	34.0	2.0	4.0	3.6	6.0	15.6	49.6
930	25.0	0	5.0	6.0	3.0	14.0	39.0	2460	27.4	2.0	4.0	3.7	6.0	15.7	43.1
940	27.5	0	5.0	6.8	3.0	14.8	42.3	2470	24.5	2.0	4.0	3.6	5.0	14.6	39.1
960	----	--	---	---	---	----	----	2510	17.0	2.0	5.0	3.2	5.0	15.2	32.2
1010	36.2	0	5.0	8.0	3.0	16.0	52.2	2520	19.0	2.0	5.0	4.2	5.0	16.2	35.2
1020	30.1	0	5.0	7.1	3.0	15.1	45.2	2530	21.0	2.0	5.0	3.4	5.0	15.4	36.4
1030	34.3	0	5.0	8.0	3.0	16.0	50.3	2540	27.0	2.0	5.0	3.1	5.0	15.1	42.1
1040	34.3	0	5.0	7.0	3.0	15.0	49.3	2610	21.0	2.0	5.0	3.1	5.0	15.1	36.1
1110	27.1	0	5.0	5.0	3.0	13.0	40.1	2620	17.0	2.0	3.8	3.6	5.0	14.4	31.4
1120	39.7	0	5.0	3.9	3.0	11.9	51.6	2630	24.2	2.0	5.0	3.4	5.0	15.4	39.6
1130	21.6	0	5.0	5.0	3.0	13.0	34.6	2640	27.0	2.0	5.0	3.4	4.4	14.8	41.8
1140	43.1	0	5.0	6.0	3.0	14.0	57.1	2710	24.0	2.0	5.0	4.8	5.0	16.8	40.8
1150	41.2	0	5.0	4.0	3.0	12.0	53.2	2720	26.0	2.0	5.0	4.8	5.0	16.8	42.8
1160	28.5	0	5.0	3.0	3.0	11.0	39.5	3010	30.0	4.0	5.0	3.0	5.0	17.0	47.0
1170	34.3	0	5.0	2.0	3.0	10.0	44.3								

TABLE B-VI
1964 TRANSIT TRAVEL TIME TO ZONE 0060
(Minutes)

ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME	ORIGIN ZONE	TRAVEL	TRANS- FER	WAIT- ING	WALKING ORIG. DEST.	EXCESS TIME	TOTAL TIME		
110	16.1	3.0	2.5	2.0	3.0	10.5	26.6	1310	36.0	3.0	5.0	3.1	2.0	13.1	49.1
120	17.4	3.0	2.5	2.7	2.6	10.8	28.2	1320	35.0	3.0	5.0	2.6	2.0	12.6	47.6
140	16.2	3.0	2.5	2.7	5.0	13.2	29.4	1330	32.0	3.0	5.0	1.9	2.0	11.9	43.9
150	15.0	3.0	5.0	3.4	1.6	13.0	28.0	1340	30.0	3.0	5.0	3.7	2.0	13.7	43.7
210	15.7	3.0	2.5	3.6	3.0	12.1	27.8	1410	30.0	3.0	5.0	4.2	2.0	14.2	44.2
220	19.0	3.0	2.5	3.4	3.0	11.9	30.9	1420	35.0	3.0	5.0	4.2	2.0	14.2	49.2
230	19.0	3.0	5.0	3.9	3.0	14.9	33.9	1430	35.9	3.0	5.0	5.6	2.0	15.6	51.5
240	18.0	3.0	5.0	2.7	2.0	12.7	30.7	1440	35.0	3.0	5.0	2.7	2.0	12.7	47.7
250	21.0	3.0	5.0	3.9	2.0	13.9	34.9	1520	30.0	5.0	5.0	3.9	3.0	16.9	46.9
260	25.5	3.0	2.5	3.4	5.0	13.9	39.4	1540	28.0	3.0	5.0	4.9	3.0	15.9	43.9
310	6.1	3.0	1.3	2.9	3.0	10.2	16.3	1550	34.0	3.0	5.0	8.0	3.0	19.0	53.0
320	7.4	3.0	1.3	2.7	3.0	10.0	17.4	1620	32.0	3.0	5.0	6.0	3.0	17.0	49.0
330	9.3	3.0	1.3	2.7	3.0	10.0	19.3	1630	28.1	3.0	5.0	0.9	3.0	11.9	40.0
340	12.0	3.0	1.3	3.1	3.0	10.4	22.4	2010	11.5	0	3.5	4.1	7.0	14.6	26.1
410	21.3	3.0	2.5	3.9	1.6	11.0	32.3	2020	6.0	0	4.0	2.7	5.0	11.7	17.7
430	23.7	3.0	2.5	3.4	3.0	11.9	35.6	2110	18.8	3.0	2.0	2.0	2.0	9.0	27.8
440	27.0	3.0	2.5	4.8	2.0	12.3	39.3	2120	17.0	3.0	3.0	3.9	4.0	13.9	30.9
510	22.5	3.0	1.3	3.4	4.0	11.7	34.2	2130	21.0	3.0	5.0	3.4	4.0	15.4	36.4
520	26.0	3.0	3.0	3.1	3.0	12.1	38.1	2140	23.0	3.0	5.0	2.7	4.0	14.7	37.7
540	26.5	3.0	5.0	4.6	2.6	15.2	41.7	2220	14.0	0	5.0	2.6	6.0	13.6	27.6
550	32.0	3.0	5.0	4.4	2.4	14.8	46.8	2230	18.0	0	5.0	3.6	6.0	14.6	32.6
560	30.2	3.0	2.5	3.7	2.4	11.6	41.8	2250	24.0	4.0	5.0	3.5	3.0	15.5	39.5
710	27.0	3.0	5.0	4.4	1.0	13.4	40.4	2310	13.0	0	2.5	3.4	7.0	12.9	25.9
720	19.0	3.0	2.5	3.6	1.0	10.1	29.1	2320	27.0	5.0	5.0	3.6	4.0	17.6	44.6
730	14.2	3.0	2.0	3.4	2.0	10.4	24.6	2330	17.0	0	5.0	3.1	7.0	15.1	32.1
810	32.0	3.0	5.0	2.9	3.0	13.9	45.9	2340	19.0	0	5.0	3.6	7.0	15.6	34.6
820	30.0	3.0	5.0	4.6	3.0	15.6	45.6	2350	32.0	5.0	5.0	4.9	3.0	17.9	49.9
830	27.0	3.0	5.0	4.8	3.0	15.8	42.8	2360	38.0	5.0	5.0	1.0	3.0	14.0	52.0
840	25.0	3.0	5.0	2.0	3.0	13.0	38.0	2370	23.0	0	5.0	4.0	3.0	12.0	35.0
860	22.0	3.0	5.0	5.8	5.0	18.8	40.8	2410	21.4	3.0	4.0	3.6	3.0	13.6	35.0
870	21.0	3.0	5.0	3.9	5.0	16.9	37.9	2420	25.0	3.0	5.0	2.7	3.0	13.7	38.7
880	21.0	3.0	5.0	4.8	5.0	17.8	38.8	2430	27.0	3.0	5.0	2.7	3.0	13.7	40.7
910	16.0	3.0	5.0	2.6	5.0	15.6	31.6	2440	29.0	3.0	5.0	3.7	3.0	14.7	43.7
920	20.0	3.0	5.0	3.4	5.6	17.0	37.0	2450	37.0	3.0	4.0	3.6	3.0	13.6	50.6
930	28.0	3.0	5.0	6.0	5.0	19.0	47.0	2460	30.4	3.0	4.0	3.7	3.0	13.7	44.1
940	30.5	3.0	5.0	6.8	5.0	19.8	50.3	2470	27.5	3.0	4.0	3.6	3.0	13.6	41.1
960	----	---	---	---	---	----	----	2510	20.0	3.0	5.0	3.2	4.0	15.2	35.2
1010	33.1	3.0	5.0	8.0	5.0	21.0	54.1	2520	22.0	3.0	5.0	4.2	4.0	16.2	38.2
1020	27.0	3.0	5.0	7.1	5.0	20.1	47.1	2530	23.0	3.0	5.0	3.4	3.0	14.4	37.4
1030	31.2	3.0	5.0	8.0	5.0	21.0	52.2	2540	30.0	3.0	5.0	3.1	3.0	14.1	44.1
1040	31.2	3.0	5.0	7.0	5.0	20.0	51.2	2610	24.0	3.0	5.0	3.1	3.0	14.1	38.1
1110	24.0	3.0	5.0	5.0	5.0	18.0	42.0	2620	22.0	3.0	3.8	3.6	3.0	13.4	35.4
1120	36.6	3.0	5.0	3.9	5.0	16.9	53.5	2630	29.2	3.0	5.0	3.4	3.0	14.4	43.6
1130	18.5	3.0	5.0	5.0	5.0	18.0	36.5	2640	30.0	3.0	5.0	3.4	3.0	14.4	44.4
1140	40.0	3.0	5.0	6.0	5.0	19.0	59.0	2710	27.0	3.0	5.0	4.8	3.0	15.8	42.8
1150	38.1	3.0	5.0	4.0	5.0	17.0	55.1	2720	30.0	3.0	5.0	4.8	3.0	15.8	45.8
1160	25.4	3.0	5.0	3.0	5.0	16.0	41.4	3010	28.0	0	5.0	3.0	4.0	12.0	40.0
1170	31.2	3.0	5.0	2.0	5.0	15.0	46.2								

APPENDIX C

TRAVEL TIME RATIOS
and
TRAVEL TIME DIFFERENCES

TABLE C-I

1961 TRAVEL TIME RATIOS FOR NORTH SIDE ORIGIN ZONES

ORIGIN ZONE	DESTINATION ZONES			ORIGIN ZONE	DESTINATION ZONES		
	10 + 20	30 + 40	60		10 + 20	30 + 40	60
110	1.32	1.90	2.11	880	2.04	1.68	2.49
120	1.43	2.00	2.12	910	1.55	1.50	1.95
140	1.56	1.42	2.04	920	1.67	1.51	2.10
150	1.70	1.83	2.35	930	1.90	1.90	2.25
210	1.79	3.00	2.83	940	2.01	1.86	2.38
220	1.65	2.21	2.07	960	----	----	----
230	2.05	3.16	3.17	1010	2.13	2.25	2.21
240	1.77	2.23	2.45	1020	2.04	2.12	2.31
250	1.98	2.62	2.53	1030	1.97	2.07	2.24
260	1.88	2.38	2.51	1040	2.05	2.12	2.29
310	1.37	1.20	2.02	1110	1.85	2.02	2.22
320	1.48	1.45	2.09	1120	2.14	2.32	2.51
330	1.54	1.37	2.07	1130	1.66	1.77	1.97
340	1.40	1.37	1.72	1140	2.55	2.68	2.85
410	1.56	1.80	1.91	1150	2.50	2.45	2.84
430	1.47	1.74	1.92	1160	2.12	2.04	2.46
440	1.65	1.84	1.96	1170	2.17	2.04	2.38
510	1.48	1.80	2.10	1310	2.04	2.14	2.07
520	1.76	2.17	2.33	1320	2.22	2.35	2.25
540	2.06	2.52	2.67	1330	2.08	2.16	2.12
550	2.02	2.41	2.35	1340	2.10	2.48	2.41
560	1.93	2.39	2.34	1410	2.13	2.47	2.46
710	2.22	2.46	2.44	1420	2.17	2.52	2.50
720	1.69	1.90	2.01	1430	2.35	2.55	2.61
730	1.71	1.71	2.05	1440	2.00	2.27	2.31
810	2.17	2.11	2.55	1520	2.18	2.34	2.45
820	2.27	2.28	2.69	1540	1.66	1.93	2.00
830	2.33	2.12	2.64	1550	2.11	2.38	2.44
840	2.19	2.03	2.56	1620	1.44	1.40	1.62
860	2.40	2.07	2.77	1630	1.27	1.17	1.42
870	2.09	1.83	2.56				

TABLE C-II

1961 TRAVEL TIME DIFFERENCES FOR NORTH SIDE ORIGIN ZONES

ORIGIN ZONE	DESTINATION ZONES			ORIGIN ZONE	DESTINATION ZONES		
	10+20	30+40	60		10+20	30+40	60
110	3.6	9.6	13.4	880	18.2	11.9	22.9
120	5.2	11.7	14.7	910	9.9	8.0	14.9
140	6.2	5.7	14.9	920	13.0	8.9	18.9
150	7.9	11.8	16.1	930	18.5	17.8	24.2
210	7.7	15.4	18.5	940	21.0	17.3	26.8
220	8.9	14.7	14.7	960	----	----	----
230	12.9	20.1	23.9	1010	26.6	28.4	26.8
240	11.1	13.9	17.6	1020	22.5	23.3	26.7
250	15.7	21.3	22.4	1030	23.7	25.5	28.8
260	14.4	21.7	26.1	1040	24.7	25.5	28.8
310	3.8	1.7	8.2	1110	18.3	19.7	23.1
320	5.2	4.0	9.4	1120	27.3	28.7	32.1
330	6.5	3.8	10.6	1130	13.6	14.6	17.9
340	5.9	4.9	9.2	1140	34.6	35.1	38.3
410	8.6	12.6	15.5	1150	31.8	30.8	35.7
430	7.9	12.7	17.0	1160	20.9	19.6	24.5
440	12.1	16.1	19.5	1170	24.0	22.0	26.7
510	7.0	11.4	17.2	1310	26.2	23.5	23.8
520	16.5	17.0	19.2	1320	30.0	27.3	27.6
540	19.7	28.3	32.4	1330	23.8	24.1	24.8
550	19.2	25.6	26.3	1340	22.9	28.8	29.4
560	15.7	22.4	23.2	1410	22.9	27.8	29.5
710	22.5	23.6	25.6	1420	24.7	30.6	32.2
720	12.5	13.8	16.4	1430	30.5	33.5	37.1
730	10.7	8.7	13.5	1440	23.7	28.7	31.3
810	21.8	19.7	27.3	1520	22.2	26.6	30.4
820	24.2	23.3	30.5	1540	14.1	20.9	23.7
830	23.6	19.7	27.5	1550	27.7	32.7	36.3
840	20.4	17.5	25.3	1620	9.6	9.6	15.6
860	22.2	16.9	26.4	1630	4.0	4.0	14.2
870	19.0	14.5	24.0				

TABLE C-III

1961 TRAVEL TIME RATIOS AND TRAVEL TIME DIFFERENCES

FROM SOUTH SIDE ORIGIN ZONES TO DESTINATION ZONE 0010+0020

[illegible]

TABLE C-VI

1964 TRAVEL TIME RATIOS FOR NORTH SIDE ORIGIN ZONES

ORIGIN ZONE	DESTINATION ZONES			ORIGIN ZONE	DESTINATION ZONES		
	10+20	30+40	60		10+20	30+40	60
110	1.33	2.00	2.12	880	1.82	1.77	2.52
120	1.38	2.05	2.15	910	1.64	1.47	2.01
140	1.40	1.66	2.05	920	1.70	1.62	2.16
150	1.62	1.90	2.35	930	1.90	1.98	2.44
210	1.61	3.03	2.75	940	2.04	2.12	2.58
220	1.47	2.16	2.25	960	----	----	----
230	1.89	3.16	3.08	1010	2.14	2.30	2.44
240	1.65	2.74	2.54	1020	2.05	2.17	2.31
250	1.55	2.44	2.49	1030	1.97	2.12	2.24
260	1.58	2.19	2.28	1040	2.06	2.17	2.30
310	1.33	1.21	2.04	1110	1.86	2.08	2.22
320	1.38	1.38	2.02	1120	2.14	2.37	2.51
330	1.40	1.25	1.95	1130	1.66	1.83	1.97
340	1.40	1.34	1.76	1140	2.55	2.73	2.86
410	1.48	1.85	1.90	1150	2.50	2.49	2.86
430	1.43	1.81	1.93	1160	2.12	2.10	2.46
440	1.57	1.86	1.94	1170	2.18	2.09	2.33
510	1.50	1.96	2.18	1310	1.74	2.29	2.20
520	1.76	2.30	2.40	1320	1.69	2.20	2.16
540	1.63	2.08	2.16	1330	1.59	2.01	1.98
550	1.92	2.41	2.35	1340	1.67	2.15	2.10
560	1.89	2.49	2.40	1410	1.75	2.23	2.19
710	1.68	2.36	2.27	1420	1.90	2.35	2.29
720	1.66	1.73	1.80	1430	1.91	2.29	2.24
730	1.62	1.61	1.91	1440	1.63	2.08	2.00
810	1.80	2.16	2.61	1520	1.89	2.22	2.23
820	1.96	2.11	2.52	1540	1.46	1.82	1.85
830	2.14	2.09	2.55	1550	1.72	2.14	2.10
840	1.81	1.88	2.35	1620	1.58	1.87	1.95
860	1.77	2.17	2.74	1630	1.31	1.55	1.67
870	1.86	1.83	2.46				

TABLE C-VII

1964 TRAVEL TIME DIFFERENCES FOR NORTH SIDE ORIGIN ZONES
(Minutes)

ORIGIN ZONE	DESTINATION ZONES			ORIGIN ZONE	DESTINATION ZONES		
	10+ 20	30+ 40	60		10+ 20	30+ 40	60
110	3.7	10.7	14.5	880	14.2	13.4	23.4
120	4.6	12.3	15.1	910	9.4	7.5	15.9
140	4.4	8.9	15.1	920	13.5	10.9	19.9
150	6.9	12.8	16.1	930	18.5	19.3	27.7
210	5.9	15.6	17.7	940	21.5	22.3	30.8
220	6.4	14.2	17.2	960	----	----	----
230	10.9	20.1	22.9	1010	26.7	29.5	31.9
240	9.4	19.7	18.6	1020	22.6	24.4	26.7
250	8.7	18.8	20.9	1030	23.8	26.6	28.9
260	9.4	18.7	22.1	1040	24.8	26.6	28.9
310	3.4	1.8	8.3	1110	18.4	20.8	23.1
320	4.1	3.4	8.8	1120	27.4	29.8	32.2
330	4.8	2.6	9.4	1130	13.7	15.7	18.0
340	5.9	4.5	9.7	1140	34.7	36.2	38.4
410	7.4	13.4	15.3	1150	31.9	31.9	35.8
430	7.1	13.9	17.2	1160	21.0	20.7	24.6
440	10.6	16.6	19.0	1170	24.1	23.1	26.8
510	7.3	13.7	18.5	1310	16.9	26.5	26.8
520	11.5	18.8	22.2	1320	15.6	24.3	25.6
540	11.7	20.1	22.4	1330	12.6	21.1	21.8
550	17.2	25.6	27.3	1340	13.6	22.3	22.9
560	15.0	24.0	24.4	1410	14.7	23.3	24.0
710	12.5	21.9	22.6	1420	18.6	27.1	27.7
720	12.0	11.3	12.9	1430	20.3	27.9	28.5
730	9.4	7.5	11.7	1440	14.6	24.2	23.8
810	14.8	20.7	28.3	1520	17.2	24.1	25.9
820	18.2	20.3	25.5	1540	10.1	18.4	20.2
830	20.1	19.2	26.0	1550	17.6	27.2	27.8
840	13.9	15.0	21.8	1620	13.6	20.9	23.9
860	12.2	18.4	25.9	1630	6.6	12.8	16.0
870	15.0	14.5	22.5				

TABLE C-VIII

1964 TRAVEL TIME RATIOS AND TRAVEL TIME DIFFERENCES

FROM SOUTH SIDE ORIGIN ZONES TO DESTINATION ZONE 0010+0020

ORIGIN ZONE	TRAVEL TIME RATIO BRIDGE PENALTY IN MINUTES					TRAVEL TIME DIFFERENCE (Minutes) BRIDGE PENALTY IN MINUTES				
	0	2	3	4	5	0	2	3	4	5
2010	2.21	1.88	1.75	1.64	1.54	13.8	11.8	10.8	9.8	8.8
2020	1.59	1.35	1.26	1.18	1.10	6.7	4.7	3.7	2.7	1.7
2110	1.70	1.43	1.32	1.23	1.15	7.4	5.4	4.4	3.4	2.4
2120	2.21	1.81	1.65	1.53	1.42	10.8	8.8	7.8	6.8	5.8
2130	2.37	2.00	1.85	1.73	1.62	14.7	12.7	11.7	10.7	9.7
2140	2.45	2.08	1.93	1.81	1.70	16.3	14.3	13.3	12.3	11.3
2220	2.40	2.09	1.97	1.86	1.76	19.2	17.2	16.2	15.2	14.2
2230	2.17	1.91	1.80	1.71	1.62	17.2	15.2	14.2	13.2	12.2
2250	2.11	1.90	1.81	1.73	1.66	20.4	18.4	17.4	16.4	15.4
2310	1.85	1.61	1.51	1.43	1.35	11.4	9.4	8.4	7.4	6.4
2320	2.45	2.12	2.00	1.88	1.78	19.1	17.1	16.1	15.1	14.1
2330	1.99	1.76	1.66	1.57	1.50	15.1	13.1	12.1	11.1	10.1
2340	2.19	1.93	1.82	1.72	1.64	17.8	15.8	14.8	13.8	12.8
2350	2.77	2.43	2.29	2.16	2.05	25.0	23.0	22.0	21.0	20.0
2360	2.56	2.27	2.15	2.04	1.94	24.4	22.4	21.4	20.4	19.4
2370	2.02	1.81	1.71	1.63	1.56	17.2	15.2	14.2	13.2	12.2
2410	1.76	1.53	1.44	1.35	1.28	10.2	8.2	7.2	6.2	5.2
2420	2.39	2.05	1.91	1.80	1.69	16.8	14.8	13.8	12.8	11.8
2430	2.27	1.98	1.86	1.76	1.67	17.6	15.6	14.6	13.6	12.6
2440	2.21	1.95	1.84	1.75	1.66	18.2	16.2	15.2	14.2	13.2
2450	2.40	2.14	2.02	1.92	1.84	22.9	20.9	19.9	18.9	17.9
2460	2.12	1.87	1.77	1.68	1.60	17.2	15.2	14.2	13.2	12.2
2470	2.15	1.88	1.77	1.68	1.59	16.4	14.4	13.4	12.4	11.4
2510	2.15	1.81	1.67	1.56	1.46	12.1	10.1	9.1	8.1	7.1
2520	2.42	2.05	1.91	1.78	1.67	15.8	13.8	12.8	11.8	10.8
2530	2.26	1.92	1.79	1.68	1.58	14.5	12.5	11.5	10.5	9.5
2540	2.51	2.18	2.04	1.92	1.82	19.8	17.8	16.8	15.8	14.8
2610	2.13	1.84	1.72	1.62	1.53	14.4	12.4	11.4	10.4	9.4
2620	1.65	1.45	1.37	1.30	1.23	9.6	7.6	6.6	5.6	4.6
2630	1.74	1.57	1.50	1.44	1.38	13.9	11.9	10.9	9.9	8.9
2640	2.10	1.87	1.77	1.68	1.60	17.5	15.5	14.5	13.5	12.5
2710	2.32	2.03	1.90	1.80	1.70	18.1	16.1	15.1	14.1	13.1
2720	2.62	2.27	2.13	2.01	1.90	21.5	19.5	18.5	17.5	16.5
3010	2.22	1.99	1.89	1.80	1.72	20.9	18.9	17.9	16.9	15.9

TABLE C-IX

1964 TRAVEL TIME RATIOS AND TRAVEL TIME DIFFERENCES

FROM SOUTH SIDE ORIGIN ZONES TO DESTINATION ZONE 0030+0040

ORIGIN ZONE	TRAVEL TIME RATIO BRIDGE PENALTY IN MINUTES					TRAVEL TIME DIFFERENCE (Minutes) BRIDGE PENALTY IN MINUTES				
	0	2	3	4	5	0	2	3	4	5
2010	2.56	2.21	2.07	1.95	1.83	19.7	17.7	16.7	15.7	14.7
2020	2.09	1.80	1.68	1.58	1.49	13.5	11.5	10.5	9.5	8.5
2110	1.94	1.70	1.60	1.51	1.43	13.3	11.3	10.3	9.3	8.3
2120	2.23	1.92	1.80	1.69	1.59	15.4	13.4	12.4	11.4	10.4
2130	2.34	2.05	1.93	1.82	1.73	19.1	17.1	16.1	15.1	14.1
2140	2.34	2.06	1.95	1.85	1.75	19.9	17.9	16.9	15.9	14.9
2220	2.47	2.15	2.02	1.91	1.81	20.0	18.0	17.0	16.0	15.0
2230	2.52	2.24	2.12	2.01	1.91	23.9	21.9	20.9	10.9	18.9
2250	2.40	2.17	2.08	1.99	1.90	27.1	25.1	24.1	23.1	22.1
2310	2.20	1.93	1.82	1.72	1.63	17.4	15.4	14.4	13.4	12.4
2320	2.80	2.46	2.32	2.19	2.08	26.1	24.1	23.1	22.1	21.1
2330	2.32	2.07	1.96	1.87	1.78	21.7	19.7	18.7	17.7	16.7
2340	2.58	2.30	2.18	2.07	1.97	25.5	23.5	22.5	21.5	20.5
2350	3.06	2.70	2.56	2.42	2.31	31.6	29.6	28.6	27.6	26.6
2360	2.76	2.48	2.36	2.24	2.14	30.6	28.6	27.6	26.6	25.6
2370	2.42	2.17	2.07	1.97	1.89	25.2	23.2	22.2	21.2	20.2
2410	2.06	1.84	1.74	1.66	1.58	17.5	15.5	14.5	13.5	12.5
2420	2.40	2.13	2.02	1.92	1.82	22.0	20.0	19.0	18.0	17.0
2430	2.27	2.04	1.94	1.85	1.76	22.2	20.2	19.2	18.2	17.2
2440	2.31	2.08	1.98	1.90	1.82	24.2	22.2	21.2	20.2	19.2
2450	2.55	2.31	2.20	2.11	2.02	30.1	28.1	27.1	26.1	25.1
2460	2.34	2.11	2.02	1.93	1.85	24.7	22.7	21.7	20.7	19.7
2470	2.24	2.00	1.91	1.82	1.74	21.6	19.6	18.6	17.6	16.6
2510	2.28	2.00	1.88	1.78	1.68	18.1	16.1	15.1	14.1	13.1
2520	2.39	2.11	1.99	1.88	1.79	20.5	18.5	17.5	16.5	15.5
2530	2.41	2.13	2.01	1.91	1.81	21.3	19.3	18.3	17.3	16.3
2540	2.52	2.25	2.14	2.03	1.94	25.4	23.4	22.4	21.4	20.4
2610	2.22	1.97	1.87	1.78	1.70	19.8	17.8	16.8	15.8	14.8
2620	1.70	1.54	1.47	1.40	1.34	13.0	11.0	10.0	9.0	8.0
2630	1.85	1.70	1.62	1.56	1.50	18.2	16.2	15.2	14.2	13.2
2640	2.13	1.94	1.85	1.77	1.70	22.2	20.2	19.2	18.2	17.2
2710	2.36	2.12	2.01	1.93	1.83	23.5	21.5	20.5	19.5	18.5
2720	2.53	2.26	2.15	2.05	1.96	25.9	23.9	22.9	21.9	20.9
3010	2.58	2.33	2.22	2.12	2.03	28.8	26.8	25.8	24.8	23.8

TABLE C-X

1964 TRAVEL TIME RATIOS AND TRAVEL TIME DIFFERENCES
FROM SOUTH SIDE ORIGIN ZONES TO DESTINATION ZONE 0060

ORIGIN ZONE	TRAVEL TIME RATIO BRIDGE PENALTY IN MINUTES					TRAVEL TIME DIFFERENCE(Minutes) BRIDGE PENALTY IN MINUTES				
	0	2	3	4	5	0	2	3	4	5
2010	2.51	2.10	1.95	1.81	1.70	15.7	13.7	12.7	11.7	10.7
2020	1.82	1.51	1.39	1.29	1.20	8.0	6.0	5.0	4.0	3.0
2110	2.42	2.06	1.92	1.79	1.68	16.3	14.3	13.3	12.3	11.3
2120	2.94	2.47	2.29	2.13	1.99	20.4	18.4	17.4	16.4	15.4
2130	2.96	2.54	2.38	2.23	2.10	24.1	22.1	21.1	20.1	19.1
2140	2.95	2.55	2.39	2.24	2.12	24.9	22.9	21.9	20.9	19.9
2220	2.30	1.97	1.84	1.73	1.62	15.6	13.6	12.6	11.6	10.6
2230	2.43	2.12	1.99	1.88	1.77	19.2	17.2	16.2	15.2	14.2
2250	2.31	2.07	1.97	1.87	1.79	22.4	20.4	19.4	18.4	17.4
2310	2.14	1.84	1.71	1.61	1.52	13.8	11.8	10.8	9.8	8.8
2320	3.63	3.12	2.92	2.74	2.58	32.3	30.3	29.3	28.3	27.3
2330	2.29	2.00	1.89	1.78	1.69	18.1	16.1	15.1	14.1	13.1
2340	2.52	2.21	2.07	1.96	1.85	20.9	18.9	17.9	16.9	15.9
2350	3.81	3.30	3.10	2.92	2.76	36.8	34.8	33.8	32.8	31.8
2360	3.38	2.99	2.83	2.68	2.55	36.6	34.6	33.6	32.6	31.6
2370	2.22	1.97	1.86	1.77	1.68	19.2	17.2	16.2	15.2	14.2
2410	2.45	2.15	2.02	1.91	1.81	20.7	18.7	17.7	16.7	15.7
2420	2.83	2.47	2.32	2.19	2.07	25.0	23.0	22.0	21.0	20.0
2430	2.63	2.33	2.20	2.09	1.99	25.2	23.2	22.2	21.2	20.2
2440	2.63	2.35	2.23	2.12	2.02	27.1	25.1	24.1	23.1	22.1
2450	2.97	2.65	2.52	2.40	2.29	33.5	31.5	30.5	29.5	28.5
2460	2.69	2.40	2.28	2.16	2.06	27.7	25.7	24.7	23.7	22.7
2470	2.69	2.38	2.25	2.13	2.03	25.8	23.8	22.8	21.8	20.8
2510	2.91	2.50	2.33	2.19	2.06	23.1	21.1	20.1	19.1	18.1
2520	2.99	2.58	2.42	2.28	2.15	25.4	23.4	22.4	21.4	20.4
2530	2.84	2.46	2.31	2.17	2.05	24.2	22.2	21.2	20.2	19.2
2540	3.00	2.64	2.49	2.36	2.24	29.4	27.4	26.4	25.4	24.4
2610	2.67	2.34	2.20	2.08	1.97	23.8	21.8	20.8	19.8	18.8
2620	2.27	2.01	1.90	1.81	1.72	19.8	17.8	16.8	15.8	14.8
2630	2.25	2.04	1.95	1.87	1.79	24.2	22.2	21.2	20.2	19.2
2640	2.52	2.26	2.15	2.05	1.96	26.8	24.8	23.8	22.8	21.8
2710	2.80	2.48	2.34	2.22	2.11	27.5	25.5	24.5	23.5	22.2
2720	3.08	2.71	2.56	2.42	2.30	30.9	28.9	27.9	26.9	25.9
3010	2.53	2.25	2.13	2.02	1.92	24.2	22.2	21.2	20.2	19.2

APPENDIX D

A COMPARISON OF THE PREDICTED MODE SPLITS TO THE ACTUAL MODE SPLITS

TABLE D-I

COMPARISON OF PREDICTED MODE SPLITS TO ACTUAL MODES SPLITS
FOR DESTINATION ZONE 0010+0020 IN 1961

Origin Zone	Actual M.S. ¹	No. of Trips	Predicted Mode Split				Origin Zone	Actual M.S. ¹	No. of Trips	Predicted Mode Split			
			TTR ²	Diff. ³	TTD ⁴	Diff. ³				TTR	Diff.	TTD	Diff.
110	67	130	66	+ 1	68	- 1	1310	23	430	31	- 8	20	+ 3
120	62	290	52	+10	58	+ 4	1320	16	250	26	-10	16	0
140	92	230	63	+29	67	+25	1330	37	80	30	+ 7	23	+14
150	65	290	60	+ 5	63	+ 2	1340	33	150	29	+ 4	25	+ 8
210	50	280	40	+10	53	- 3	1410	20	100	20	0	15	+ 5
220	38	130	36	+ 2	40	- 2	1420	35	170	20	+15	12	+23
230	53	390	31	+22	44	+ 9	1430	66	30	24	+42	16	+50
240	66	60	31	+35	37	+29	1440	33	60	32	+ 1	24	+ 9
250	12	160	23	-11	28	-16	1520	47	210	33	+14	38	+ 9
260	43	170	36	+ 7	41	+ 2	1540	41	170	44	- 3	41	0
310	57	190	54	+ 3	60	- 3	1550	--	--	--	--	--	--
320	54	270	50	+ 4	57	- 3	1620	21	140	51	-30	50	-29
330	52	210	48	+ 4	55	- 3	1630	40	200	57	-17	60	-20
340	55	200	46	+ 9	46	+ 9	2010	66	180	18	+48	33	+33
410	52	190	63	-11	61	- 9	2020	31	190	27	+ 4	42	-11
430	48	310	50	- 2	53	- 5	2110	52	380	38	+14	50	+ 2
510	55	490	64	- 9	64	- 9	2120	55	90	49	+ 6	60	- 5
520	53	320	57	- 4	48	+ 5	2130	33	240	41	- 8	49	-16
540	47	170	21	+26	21	+26	2140	50	80	38	+12	43	+ 7
550	41	120	41	0	43	- 2	2220	0	150	0	0	2	- 2
560	45	440	46	- 1	49	- 4	2230	26	190	17	+ 9	24	+ 2
710	16	120	32	-16	37	-21	2250	--	--	--	--	--	--
720	54	220	43	+11	44	+10	2310	48	270	25	+23	38	+10
730	33	420	42	- 9	48	-15	2320	54	110	25	+29	32	+22
810	27	220	27	0	27	0	2330	35	340	25	+10	35	0
820	31	220	25	+ 6	23	+ 8	2340	60	90	28	+32	39	+21
830	50	100	17	+33	14	+36	2350	0	100	10	-10	19	-19
840	20	50	19	+ 1	20	0	2360	--	--	--	--	--	--
860	37	270	23	+14	27	+10	2370	36	110	14	+22	9	+27
870	25	390	21	+ 4	23	+ 2	2410	43	160	33	+10	42	+ 1
880	42	400	31	+11	34	+ 8	2420	42	140	36	+ 6	45	- 3
910	4	250	4	0	4	0	2430	30	200	38	- 8	43	-13
920	42	280	35	+ 7	33	+ 9	2440	40	100	26	+14	30	+10
930	8	360	25	-17	23	-15	2450	--	--	--	--	--	--
940	0	90	2	- 2	3	- 3	2460	36	190	24	+12	27	+ 9
960	0	10	--	--	--	--	2470	50	140	24	+26	29	+21
1010	0	90	28	-28	19	-19	2510	20	150	42	-22	52	-32
1020	9	110	31	-22	26	-17	2520	27	180	27	0	37	-10
1030	0	70	33	-33	24	-24	2530	28	210	41	-13	49	-21
1040	0	120	21	-21	12	-12	2540	40	100	37	+ 3	44	- 4
1110	50	40	51	- 1	45	+ 5	2610	45	200	35	+10	33	+12
1120	22	90	34	-12	29	- 7	2620	58	120	33	+25	41	+17
1130	50	20	61	-11	53	- 3	2630	31	220	35	- 4	33	- 2
1140	--	--	--	--	--	--	2640	28	360	22	+16	28	+10
1150	33	90	22	+11	16	+17	2710	14	70	18	- 4	22	- 8
1160	13	150	29	-16	29	-16	2720	0	30	13	-13	17	-17
1170	0	120	27	-27	23	-23	3010	0	20	--	--	--	--

¹Mode split as determined from the origin destination survey²Mode split determined from the travel time ratio curves³Actual mode split minus the predicted mode split⁴Mode split determined from the travel time difference curves

TABLE D-II
COMPARISON OF PREDICIED MODE SPLITS TO ACTUAL MODE SPLITS
FOR DESTINATION ZONE 0030+0040 IN 1964

Origin Zone	Actual M.S. ¹	No. of Trips	Predicted Mode Split				Origin Zone	Actual M.S.	No. of Trips	Predicted Mode Split			
			TTR ²	Diff. ³	TTD ⁴	Diff. ³				TTR	Diff.	TTD	Diff.
110	87	17	44	+43	46	+41	1310	23	117	18	+ 5	15	+ 8
130	68	28	19	+49	27	+41	1320	30	90	19	+11	18	+12
140	58	37	58	0	48	+10	1330	22	60	20	+ 2	20	+ 2
150	45	51	48	- 3	44	+ 1	1340	17	83	19	- 2	19	- 2
210	38	82	16	+22	25	+13	1410	24	41	19	+ 5	13	+11
220	30	33	19	+11	20	+10	1420	26	86	18	+ 8	10	+16
230	12	82	15	- 3	21	- 9	1430	18	17	18	0	13	+ 5
240	30	10	16	+14	15	+15	1440	29	31	19	+10	18	+11
250	14	36	18	- 4	16	- 2	1520	31	51	34	- 3	30	+ 1
260	37	46	25	+12	36	+ 1	1540	16	49	20	- 4	20	- 4
310	24	92	44	-20	35	-11	1550	11	18	19	- 8	14	- 3
320	34	97	38	- 4	34	0	1620	21	72	20	+ 1	20	+ 1
330	31	58	43	-12	35	- 4	1630	25	56	30	- 5	27	- 2
340	40	65	38	+ 2	32	+ 8	2010	16	25	19	- 3	24	- 8
410	44	32	50	- 6	43	+ 1	2020	21	38	24	- 3	25	- 4
430	32	44	35	- 3	42	-10	2110	36	81	36	0	30	+ 6
440	28	64	20	+ 8	18	+10	2120	33	15	60	-27	47	-14
510	48	85	46	+ 2	42	+ 6	2130	25	63	23	+ 2	24	+ 1
520	34	73	32	+ 2	36	- 2	2140	40	25	37	+ 3	41	- 1
540	22	27	19	+ 3	15	+ 7	2220	3	34	3	0	5	- 2
550	45	33	30	+15	27	+18	2230	22	32	8	+14	9	+13
560	31	71	29	+ 2	30	+ 1	2250	0	11	3	- 3	0	0
710	18	39	30	-12	32	-14	2310	27	55	21	+ 6	26	+ 1
720	27	98	23	+ 4	28	- 1	2320	50	18	18	+32	19	+31
730	31	96	28	+ 3	31	0	2330	12	50	20	- 8	22	-10
810	23	64	19	+ 4	21	+ 2	2340	38	34	19	+19	19	+19
820	8	13	19	-11	21	-13	2350	36	11	17	+19	23	+13
830	13	40	19	- 6	16	- 3	2360	13	16	18	- 5	9	+ 4
840	19	16	20	- 1	19	0	2370	12	34	19	- 7	14	- 2
860	29	66	19	+10	23	+ 6	2410	28	36	41	-13	44	-16
870	19	97	21	- 2	19	0	2420	37	27	35	+ 2	38	- 1
880	15	91	22	- 7	26	-11	2430	27	30	22	+ 5	24	+ 3
910	7	45	7	0	7	0	2440	15	59	21	- 6	16	- 1
920	27	62	24	+ 3	23	+ 4	2450	30	23	20	+10	17	+13
930	6	109	9	- 3	11	- 5	2460	16	45	20	- 4	21	- 5
940	4	51	4	0	2	+ 2	2470	21	47	22	- 1	24	- 3
960	--	--	--	--	--	--	2510	10	41	24	-14	27	-17
1010	8	79	18	-10	10	- 2	2520	17	42	21	- 4	18	- 1
1020	18	44	19	- 1	18	0	2530	25	56	21	+ 4	24	+ 1
1030	2	53	19	-17	15	-13	2540	16	25	20	- 4	21	- 5
1040	0	32	7	- 7	0	0	2610	27	52	24	+ 3	22	+ 6
1110	5	21	40	-35	34	-29	2620	36	42	24	+12	23	+13
1120	32	37	30	+ 2	20	+12	2630	10	73	21	-11	18	- 8
1130	64	11	51	+13	40	+24	2640	18	113	19	- 1	14	+ 4
1140	4	24	25	-21	4	0	2710	13	86	9	+ 4	12	+ 1
1150	9	53	21	-12	16	- 7	2720	9	107	9	0	14	- 5
1160	13	39	27	-14	34	-21	3010	0	29	7	- 7	1	- 1
1170	15	39	19	- 4	19	- 4							

¹Mode split as determined from the origin destination survey

²Mode split determined from the travel time ratio curves

³Actual mode split minus the predicted mode split

⁴Mode split determined from the travel time difference curves

TABLE D-III

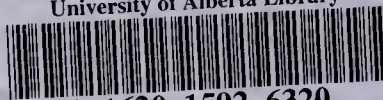
COMPARISON OF PREDICTED MODE SPLITS TO ACTUAL MODE SPLITS
FOR DESTINATION ZONE 0060 IN 1964

Origin Zone	Actual M.S. ¹	No. of Trips	Predicted Mode Split				Origin Zone	Actual M.S.	No. of Trips	Predicted Mode Split			
			TTR ²	Diff. ³	TTD ⁴	Diff. ³				TTR	Diff.	TTD	Diff.
110	52	26	42	+10	44	+ 8	1310	23	81	23	0	15	+ 8
120	50	26	24	+26	44	+ 6	1320	30	69	24	+ 6	16	+14
140	33	29	42	- 9	44	-11	1330	29	48	30	- 1	21	+ 8
150	55	34	40	+15	43	+12	1340	22	63	26	- 4	20	+ 2
210	31	63	27	+14	27	+ 4	1410	29	41	23	+ 6	18	+11
220	38	34	21	+17	27	+11	1420	27	76	20	+ 7	14	+13
230	16	83	16	0	20	- 4	1430	36	44	22	+14	13	+23
240	12	16	18	- 6	25	-13	1440	40	20	29	+11	40	0
250	27	40	18	+ 9	23	+ 4	1520	42	40	41	+ 1	38	+ 4
260	30	26	40	-10	42	-12	1540	14	28	31	-17	23	- 9
310	13	128	28	-15	38	-25	1550	12	8	26	-14	34	-22
320	29	94	29	0	37	- 8	1620	42	35	31	+11	40	+ 2
330	34	52	31	+ 3	35	- 1	1630	35	48	36	- 1	43	- 8
340	44	43	33	+11	24	+20	2010	18	49	31	-13	33	-15
410	32	31	44	-12	44	-12	2020	22	47	38	-16	38	-16
430	24	33	43	-19	43	-19	2110	48	85	36	+12	45	+ 3
440	38	57	27	+11	25	+13	2120	75	8	43	+32	44	+31
510	43	100	41	+ 2	43	0	2130	42	59	26	+16	43	- 1
520	50	59	39	+ 1	42	- 2	2140	36	19	42	- 6	42	- 6
540	28	38	24	+ 4	20	+ 8	2220	7	13	8	- 1	8	- 1
550	34	26	40	- 6	35	- 1	2230	7	41	25	-18	16	- 9
560	49	57	39	+10	40	+ 9	2250	10	10	7	+ 3	7	+ 3
710	62	24	40	+22	41	+21	2310	18	71	36	-18	35	-17
720	37	106	34	+ 3	33	+ 4	2320	30	23	16	+14	22	+ 8
730	41	82	32	+ 9	45	- 4	2330	20	49	32	-12	30	-10
810	18	86	18	0	13	+ 5	2340	34	58	27	+ 7	26	+ 8
820	30	13	18	+12	16	+14	2350	30	20	15	+15	6	+24
830	29	48	8	+21	16	+13	2360	0	19	7	- 7	6	- 6
840	6	16	10	- 4	21	-15	2370	6	49	33	-27	28	-22
860	26	61	17	+ 9	16	+10	2410	47	46	45	+ 2	44	+ 3
870	11	85	18	- 7	20	- 9	2420	46	28	42	+ 4	42	+ 4
880	18	127	18	0	19	- 1	2430	26	26	30	- 4	23	+ 3
910	7	28	7	0	7	0	2440	26	41	23	+ 3	21	+ 5
920	28	39	16	+12	13	+15	2450	15	19	20	- 5	13	+ 2
930	10	110	9	+ 1	10	0	2460	16	54	27	-11	20	- 4
940	4	21	4	0	4	0	2470	34	47	29	+ 5	42	- 8
960	--	--	--	--	--	--	2510	25	35	18	+ 7	26	- 1
1010	3	66	18	-15	8	- 5	2520	19	62	17	+ 2	23	- 4
1020	18	32	20	- 2	15	+ 3	2530	15	73	18	- 3	25	-10
1030	4	50	22	-18	12	- 8	2540	27	44	22	+ 5	18	+ 7
1110	0	1	--	--	--	--	2620	37	32	18	+17	13	+24
1120	12	33	36	-24	22	-10	2630	16	86	24	- 8	24	- 8
1130	57	7	43	+14	43	+14	2640	10	128	10	0	16	- 6
1140	0	23	25	-25	6	- 6	2710	10	64	19	- 9	12	- 2
1150	13	29	15	- 2	11	+ 2	2720	12	101	11	+ 1	10	+ 2
1160	31	22	37	- 6	39	- 8	3010	10	64	18	- 8	12	- 2
1170	13	29	20	- 7	36	-23							

¹Mode split as determined from the origin destination survey²Mode split determined from the travel time ratio curves³Actual mode split minus the predicted mode split⁴Mode split determined from the travel time difference curves

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